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Heating Piping & Air Conditioning

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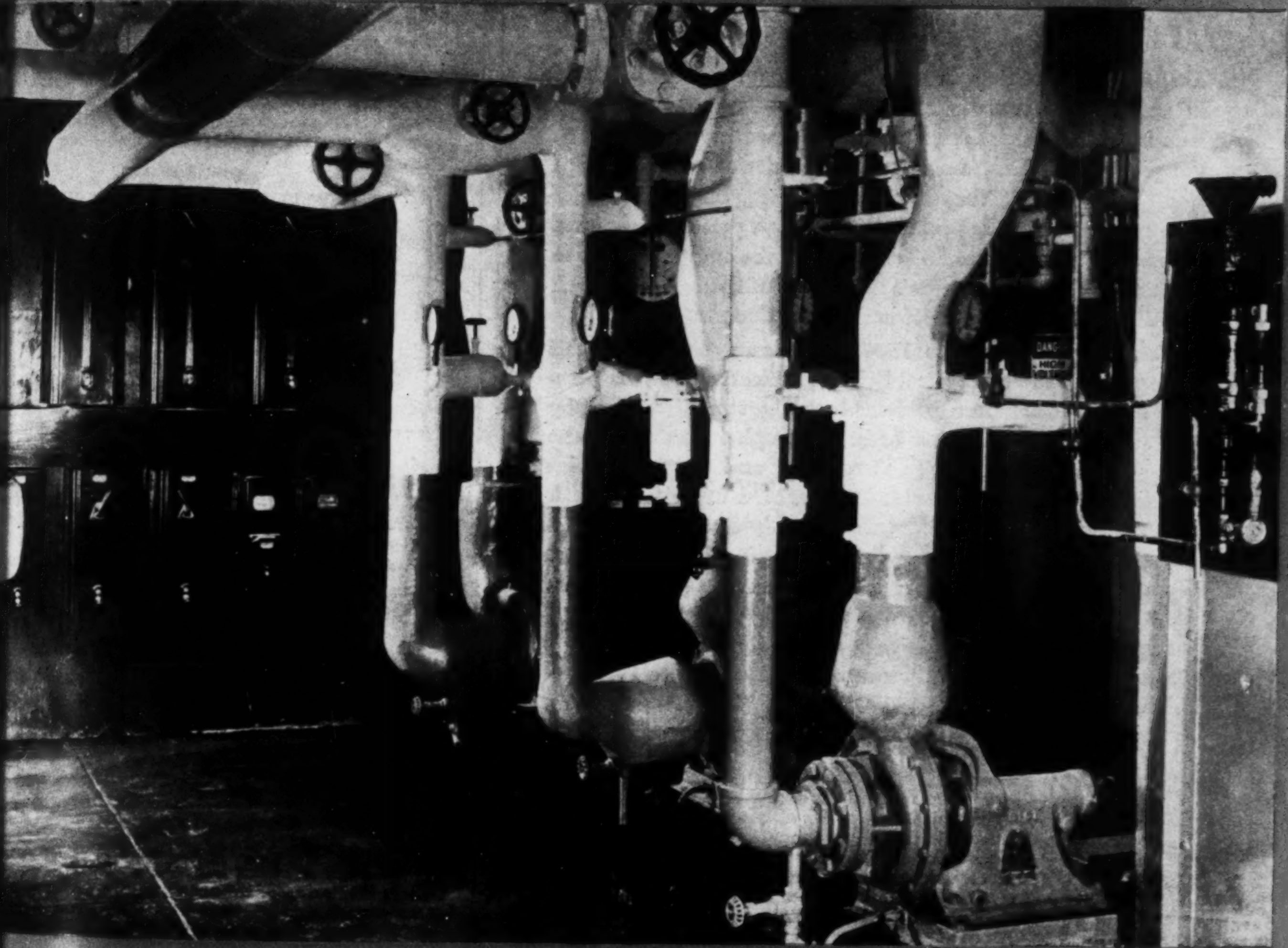
FEBRUARY ★ 1947

DESIGN
INSTALLATION
OPERATION
MAINTENANCE

e 101 — Journal Section of the American Society of Heating and Ventilating Engineers



How a 20 year old, 10 story office building was modernized with air conditioning is described this month by James A. Evans

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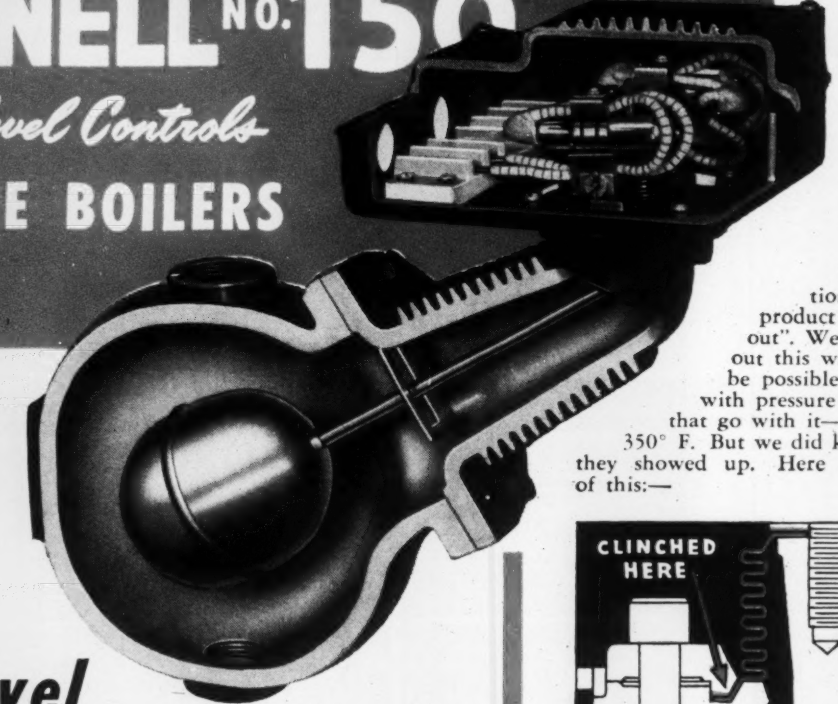
McDONNELL NO. 150

Boiler Water Level Controls for PRESSURE BOILERS

Sam, you better SCRAM!

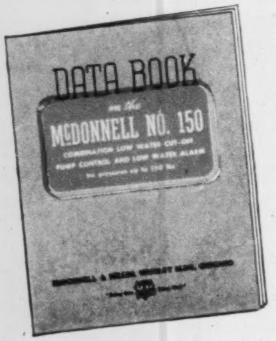


A Water Level Control you can TRUST!

The toughest problem in boiler water level control is found in the higher pressure steam boilers—the boilers in the laundry, the milk plant, the bottling works, the hospital, the public building, the industrial plants of every description. We say it is the toughest problem, but this applies only to *our* part of the problem. The tough part of water level control for the pressure boiler is the job the equipment has to perform, and this part is well taken care of by the McDonnell No. 150 Low Water Cut-off and Pump Control.

Yes, the McDonnell No. 150 is built down to the last detail to cope with the trying conditions encountered in the pressure boiler. It has been perfected step by step as typified by the refinements illustrated here. Although it went into the war as a highly perfected control, new and tougher service taught us still more about it and enabled us to improve it still further. It has proved its case in thousands of installations; has been recognized by highest engineering authorities —recommended by a large number of manufacturers of boiler feed pumps and adopted as standard equipment by many manufacturers of automatically-fired pressure boilers. It is the water level control these manufacturers place full confidence in; the control in which *you* can place full confidence.

Ask for the No. 150 Data Book . . .



The methods of installing and wiring the No. 150 have been worked out for you in a way that makes any application reasonably simple. Five readily accessible terminals provide circuits for: (1) Low Water Cut-off. (2) Low Water Alarm. (3) Control of electric condensation pump. (4) Any combination of these functions. Easily followed installation and wiring diagrams cover every condition. All the facts are covered by the No. 150 Data Book. Ask for your copy.

McDONNELL & MILLER, INC.

1316 Wrigley Building, Chicago 11, Ill.

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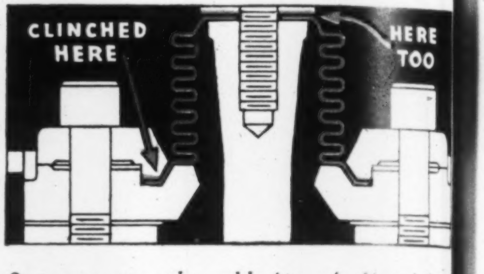
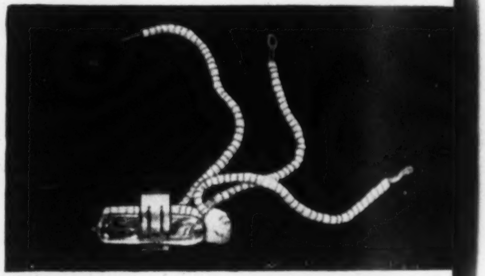
REG. U. S. PAT. OFF.

Perfecte in the field

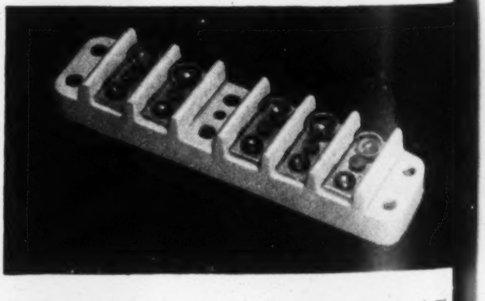
The simplest descrip-
tion of the No. 150 is, "A
product with all the bugs taken
out". We do not say it started
out this way. That just couldn'
be possible when you're dealing
with pressure and the temperatures
that go with it—sometimes up around
350° F. But we did kill the bugs as fast as
they showed up. Here are a few examples
of this:—



One case was the soldering of the sylphon. Although we removed it from the heat of the float bowl, trouble showed up in a few cases. The drawing shows how we stopped this with a mechanical seal that never lets go. It involved precision machining—added cost—but it does the job.



Another example was the wiring. Although we used the best heat-resisting insulation commercially available, the heat occasionally caused trouble. The photograph shows how we changed to porcelain-bead insulation. This costs more but it ends the trouble.



Still another example is the terminal panel. Th best insulating fibres didn't suit us, so we changed to a cast porcelain block as shown. More expensive, but it does the job.

Still other refinements were the limit stops on switches which prevent improper setting; special high-temperature switches; extra strong sylphons and so on. Because of all these refinements you have in the McDonnell No. 150 a control you ca *trust* on those pressure jobs.

The No. 150 is for steam boilers of any size hand fired or automatically fired; maximum steam pressure, 150 lbs. It is furnished with or without manual reset.

THE EDITOR'S PAGES

BIGGEST BUILDING YEAR IN HISTORY SEEN

The biggest year in the nation's history is predicted in the Architectural Forum's 1947 building forecast. Based on a study of the opinions of U. S. economists and building leaders, the forecast shows total construction expenditures for this year reaching an incredible $20 billion peak, an increase of 26 per cent over 1946.

Even measured in uninflated 1939 building dollars, worth only about 67c each today, the Forum forecast amounts to approximately $13.5 billion, or 30 per cent more than the 1939 total.

Analyzing returns from over 200 queries, Forum editors predict the beginning of the end of the housing crisis. Approximately 1,200,000 new dwelling units will get under way in 1947, topping the 1,000,000 started in 1946.

Material shortages, building's most hampering 1946 problem, are rapidly easing. Production of the four most important materials—lumber, cement, brick and asphalt roofing—has climbed well above 1939 averages. In fact, says the forecast, unless work stoppages intervene, "there even may be an oversupply of some materials and a switch of emphasis from production to selling."

Postponement of much of 1947's scheduled building with a subsequent threat to national prosperity is seen, however, if building costs continue to rise. "Such curtailment," says the Forum, "would appear first in industrial classifications, where projects are big and closely related to long term economic considerations." Under such curtailment, industrial employment and production would undoubtedly suffer.

The supply of building labor, no great problem in 1946, is feared as a potential 1947 bottleneck by industry observers. If this fear is realized, site labor costs will increase. Government and labor leaders, however, feel that the market will be relatively stable, with the supply of new or untapped labor sufficient to handle building's boom year.

New construction will account for approximtaely $13.1 billion of the $20.2 billion total, with a whopping $6.9 billion scheduled for maintenance and repair expenditures. Private funds will account for 80 per cent of the new construction total, with housing getting the lion's share. Public construction is expected to advance 27 per cent over 1946 to a $2.7 billion volume.

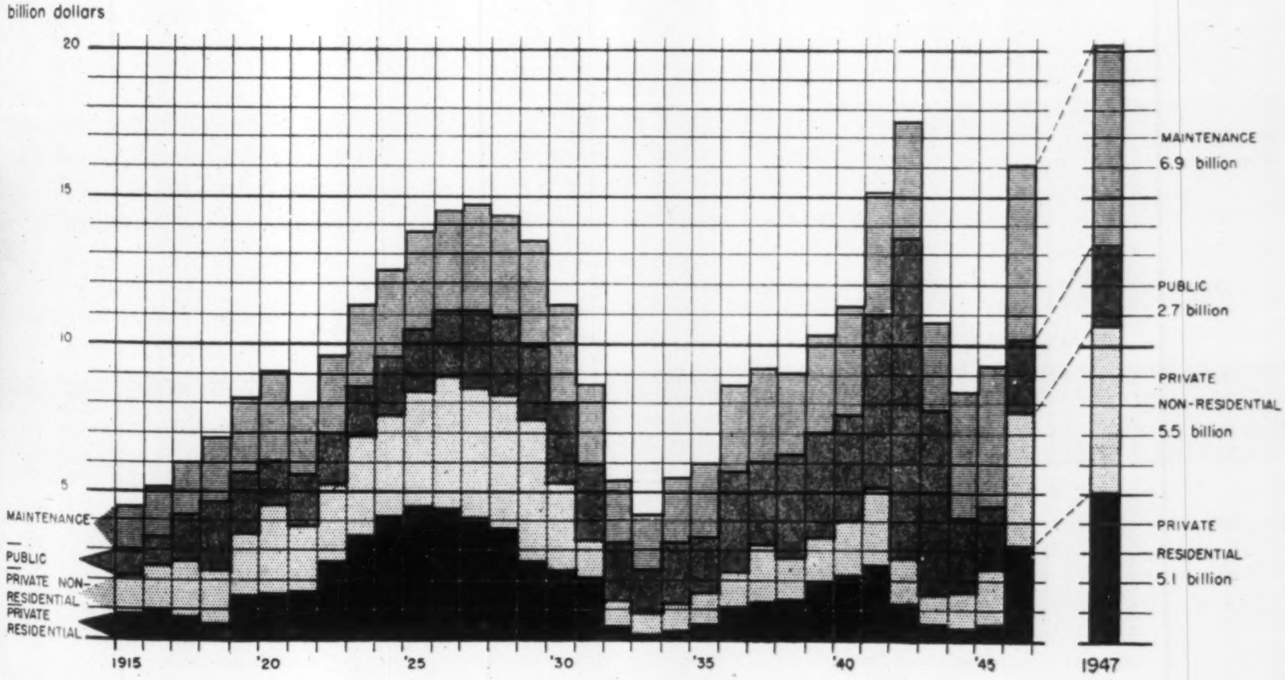
Of the $10.6 billion slated for private construction, residential building will account for $5.1 billion, approximately double 1946 expenditures. Private non-residential activity will amount to $3.9 billion, up 14 per cent over 1946. Industrial building will account for about half of this figure. At the end of the private scale come farms and privately owned utilities, which will spend $410 million and $1.2 billion, respectively.

Geographically the building spotlight will continue to focus on the West Coast. Los Angeles, which led the cities last year, will probably continue in that position, with New York, Detroit, Chicago, Philadelphia, Houston, San Francisco, Baltimore, Dallas and Seattle following in that order.

ANNOUNCES AWARDS FOR UNIT HEATER ARTICLES

The Industrial Unit Heater Association, 5-208 General Motors Bldg., Detroit 2, Mich., has announced $500 in cash awards for articles on the use of steam or hot water unit heaters.

Building forecast for this year is $20.2 billion



THE EDITOR'S PAGES

Any person is eligible to compete in the contest except the staff of the IUHA and the members of the award committee. Articles shall be submitted or mailed in triplicate, typewritten and double spaced, to the association. All articles offered become the exclusive property of the association, which may or may not release them to the public.

Articles shall be written in such a way that they are of benefit to the unit heater industry as a whole and not for the purpose of serving any company or individual. No limit is placed on the scope of the subject matter, but awards will be made on those articles which show the advantages of unit heaters in heating industrial and commercial buildings.

The contest closes March 1, 1947, and awards will be made on March 15. The award committee comprises the president, the chairman of the engineering committee, and the chairman of the publicity committee of the association. This committee shall be the sole judge as to the merit of articles and the amount of the awards.

REMA PLANS EXPOSITION EVERY OTHER JANUARY

A "permanent, far-reaching policy of national refrigeration and air conditioning expositions, centering around the holding of one all-industry show every two years beginning in January 1948" was announced last month by the Refrigeration Equipment Manufacturers Association.

The program was voted unanimously by directors of the association following an analysis of the results of the fourth all-industry refrigeration and air conditioning exposition in Cleveland last fall which was three times larger in size and attendance than any other comparable event in the industry's history.

Inaugurating the new policy will be the fifth all-industry exposition, which will be held in the Cleveland public auditorium, January 26, 27, 28 and 29, 1948, under the sole sponsorship of REMA. Thereafter, REMA will sponsor exhibitions every two years, an event already having been scheduled for January 1950.

CONDENSING UNIT STANDARD EFFECTIVE

F. E. Powell, of the division of trade standards of the National Bureau of Standards, Washington 25, D. C., has announced that commercial standard CS107-45, covering commercial electric refrigeration condensing units, is to be effective for new production from February 20, 1947.

ENGINEERS AND BUILDERS REPORT LARGE VOLUME

George A. Bryant, president and general manager of the Austin Co., engineers and builders, advised the stockholders last month that the volume of business contracted for and built in 1946 was $4\frac{1}{2}$ times the largest pre-war billing in the company's history. He said a substantial amount of work is being carried forward into 1947 and that total volume for the year should more than equal that of 1946. Contracts in effect cover a wide range of industries located in all parts of the country.

In addition to the active projects, he reported that a number of industries are showing increased interest in the opportunities to reduce production and distribution cost by construction of new plants.

AIR CONDITIONING SHOW TO BE HELD NEXT YEAR

An 8th International Heating, Ventilating, and Air Conditioning Exposition, sponsored by the American Society of Heating and Ventilating Engineers and held in conjunction with the ASHVE's 54th annual meeting, is being planned for the first week in February 1948 for New York or Philadelphia, depending upon hotel and exhibit facilities.

The 7th "air conditioning show" and the society's 53rd annual meeting, held the last week of last month in Cleveland, were record-breakers in number of exhibits and number in attendance; a registration at the meeting of well over 2000 set an all-time high.

Complete proceedings of the meeting, a story on the entertainment, and information on "side-line" activities will appear in the ASHVE Journal Section in the March HPAC. Some of the papers have already been published in the December and January issues, three of them are printed this month, and a remaining one is scheduled for March.

LIKES ARTICLE ON WELDING ALLOY PIPING

"I was very much interested in the article Welding Alloy Steel Piping, by Eric R. Seabloom, in the December HPAC.

"This article contained much valuable information that I would like to pass on to other men in our organization; therefore, would it be possible for you to send me two reprints?"—C. H. M., Maintenance Superintendent.

HEATING, A. C. DIVISIONS EXPAND

New appointments and additions to the executive sales staff in line with expansion of various divisions of the Fedders-Quigan Corp. have been announced by Edmund R. Walker, vice president. In commenting on this expanded program, Mr. Walker said that the "addition of new products such as unit air conditioners for room cooling together with aggressive re-entry into the commercial refrigeration field with postwar designs is the result of enlarged engineering and laboratory staff and facilities, increased and modernized production equipment, and nationwide sales programs."

The heating division manufactures horizontal and downblow unit heaters. C. W. Little is sales manager of this division.

The refrigeration and unit air conditioner divisions are in the charge of E. A. Bonneville.

WYATT JOINS R. B. HAYWARD CO.

H. C. Wyatt, formerly vice president in charge of the Chicago office of Mehring & Hanson Co., heating, ventilating and air conditioning contractors, has joined the R. B. Hayward Co., Chicago, ventilating and air conditioning contractors, as vice president, according to W. A. Kuechenberg, president of the Hayward organization.

Penton Profit $2,515.82 on $3,351.00 investment

THE PENTON BUILDING, Cleveland, Ohio
Home of The Penton Publishing Company. Built in 1922. Webster Heating Modernization Program completed in 1940. Heating Contractor, The Smith & Oby Company.

Perhaps you can do in 1947 What Penton Publishing Co. did in '40

Perhaps this case parallels *yours* . . .

When the 9-story Penton Building in Cleveland, Ohio, was built in 1922-23 it was equipped with a modern Webster Vacuum System of Steam Heating which operated efficiently for many years. Repairs and replacements were few and far between.

By the mid-thirties new developments . . . and in particular the Webster Moderator System . . . made new standards of performance possible.

In 1939 Webster offered the Penton Building a unique Heating Modernization Contract.

Three years later, on May 5, 1943, E. L. Shaner, President of Penton, in releasing Webster from its guarantee of performance, reported savings of $2,515.82 and added "We are completely satisfied with the manner in which our building now is being heated and commend Warren Webster & Company for the satisfactory way in which it has fulfilled its contract".

The Webster Heating Modernization Contract which provided for these results was a profit-sharing instrument. Webster furnished expertly sized Webster Metering Orifices. Webster Electronic Moderator Control with an Automatic Outdoor Thermostat and related devices provided for continuous heating from all radiators, automatically varying that heating with the demand.

It also included the results of a survey with a statement of estimated savings, this being based on Webster's experience in estimating and keeping records of performance in several hundred buildings. It included a guarantee of savings based on the least favorable experience.

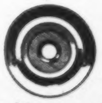
The Owner's part of this cooperative agreement included payment to an established heating contractor to make the installation, and operation in the agreed-upon manner to assure the savings results.

Not only the materials but the skill and ability of trained, long-service men is available *now*. If your case is parallel to that of Penton in 1939, why not consider a similar program for your own building? We are ready to work with you.

WARREN WEBSTER & CO., Camden, N. J.
Representatives in principal U. S. Cities : : Est. 1888
In Canada, Darling Brothers, Limited, Montreal

Webster
HEATING SYSTEMS

Webster Heating Equipment for Modernization

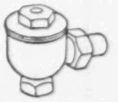


Webster Metering Orifices, expertly sized, a vital feature of the Moderator System, balance distribution and make possible central control with continuous heating.

Webster Outdoor Thermostat Control automatically provides the lowest pressure for comfortable inside temperature.

Webster Electronic Moderator Control Cabinet provides continuous heating, always under control.

Motor Operated Webster Control Valve—specially designed to provide *continuous* controlled steam delivery in low pressure heating.



Webster Thermostatic Radiator Trap—the world's best known radiator trap.

INSTALL NOW—ALL AVAILABLE FOR IMMEDIATE DELIVERY

To curb excessive maintenance...

Eight services are

BYERS WROUGHT IRON

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Navy Dept., Bureau of Yards and Docks
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Chas. G. Heyne & Co., Mechanical Contractors
BYERS
IRON

The new $11,000,000 General Hospital recently completed at Houston, Texas, by the Navy Department, gives some splendid examples of "Preventive Engineering" as applied to the control of maintenance in corrosive piping services. Piping materials were carefully matched to conditions.

The project comprises a total of 37 buildings. In the principal buildings, galvanized wrought iron was used for downspouts and underground gas lines, and black wrought iron for the concealed steam supply lines and steam return lines.

In the balance of the project, including 14 one-story ward buildings, store building, power plant, shop building, greenhouse, three residences, gate house, officers quarters, steam tunnels, water distribution system, swimming pool and site improvements, wrought iron was specified in a number of services. The interior downspouts, underground sanitary piping 1½-in. and smaller, air lines, underground water lines 3-in. and smaller, underground sprinkler system piping, and all hot and cold water lines within buildings were galvanized wrought iron. Steam supply lines in concealed or furred space, exposed steam return lines, and underground gas lines, were black wrought iron. The steam returns in concealed or furred locations were extra heavy wrought iron.

With maintenance and repair costs rising, the only protection against excessive future maintenance is to use materials that will last. Wrought Iron is unusually resistive to corrosion, because of its unique structure. The tiny fibers of silicate slag threaded through the high-purity iron body, halt and diffuse attack. The fibers also help to anchor the initial protective scale, which shields the underlying metal.

Our Engineering Service Department is always ready to suggest those places where wrought iron can be expected to last longest. You will find some excellent information on piping problems in our bulletin, "Wrought Iron for Piping Systems." Ask for a copy.

A. M. Byers Co., Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, Seattle, San Francisco.

CORROSION COSTS YOU MORE THAN WROUGHT IRON

"ETERNALLY YOURS"—professionally-produced 16mm sound motion picture. An entertaining saga of the wrought iron industry, available to technical groups. New, authentic, informative. Write Modern Talking Picture Service, Inc., 9 Rockefeller Plaza, N.Y. 20, N.Y.

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Operation, and Maintenance:
Industrial, Commercial, Institutional,
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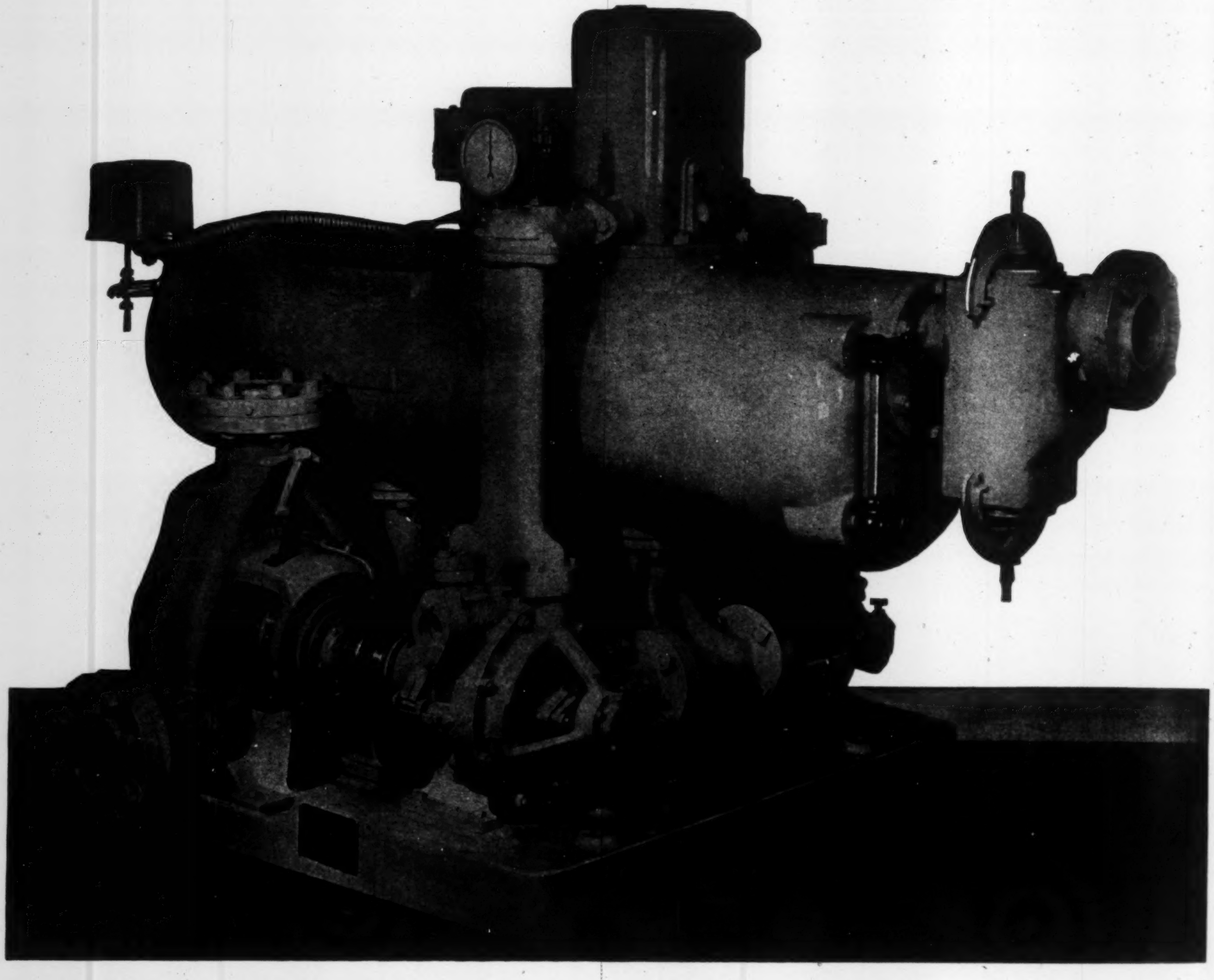
Where Heat Must Not Fail— Install this SAFE Heating Pump!



In Hospitals, Greenhouses, Schools, Public Buildings, Theatres, wherever heating systems must not fail, install the Nash Vapor Turbine, for it is entirely independent of electric current failure, and continues to operate as long as there is steam in the system.

More than that, the Vapor Turbine is a most economical pump, for the elimination of electric current does away with current cost, the largest single item in the operation of an ordinary return line heating pump.

Greater savings still are effected by the Vapor Turbine in the system, for the reason that this pump operates continuously. It is the only pump that can do this with economy. Continuous operation means uniform circulation, and uniform circulation saves steam.

The Nash Vapor Turbine has but one moving part, rotating in the casing without metallic contact, and requiring no internal lubrication. Quiet, compact, and trouble-proof. Bulletin A-290 is free on request.

THE NASH ENGINEERING COMPANY
SOUTH NORWALK, CONNECTICUT, U. S. A.

OFFICE BUILDING MODERNIZED

Occupants Not Inconvenienced During Conditioning Installation

James A. Evans Explains System for Twenty Year Old, Ten Story Building in Birmingham

IN THESE DAYS of difficulties in securing labor and materials, it is almost news enough when the completion of a year around air conditioning system for a medium sized office building can be announced. More remarkable, however, is the fact that a most modern installation has been made in an occupied building during normal working hours without seriously inconveniencing the tenancy.

Air Conditioning a "Must"

The Liberty National building, Birmingham, Ala., is owned and entirely occupied by the home office of the Liberty National Life Insurance Co., of which Frank P. Samford is president. The building was constructed over 20 years ago and, until recently, was partially rented in groups of offices to various firms. The rapid growth of the company made it necessary for it to take over the entire building for its own uses. At this time, it was decided to modernize the entire structure completely and to redecorate both the exterior and interior. Air conditioning was one of the "musts."

The building is 10 stories high and has about 45,500 sq ft of office floor space. Construction is reinforced concrete framing, with brick and tile walls, and with pan type concrete floors. Interior partitions forming corridors are of hollow tile, with the upper part glass and wood construction. This corridor construction, in conjunction with low ceilings, became an important factor in the choice of a conduit system of air distribution for the building.

Due to the inherent confusion of moving out tenants having varying terminal dates of leases, enlargement and consolidation of departments, and repairs to the building, it seemed impossible to predict which floors and spaces would be occupied by any department in the future. Consequently, it was considered that a great degree of flexibility in the air distribution system would be an essential in the selection of equipment. The system employed—using under-the-window units each with its individual control—appeared to offer the most desirable means of securing the desired flexibility. During the six months of construction, partitions were added or removed and entire floors changed character of occupancy, clearly demonstrating the correctness of the original decision.

Outdoor Air Not "Fresh"

Birmingham is sometimes called "the Pittsburgh of the South." While this appellation refers particularly to the concentration of iron and steel manufacture in the Birmingham area, it might more correctly refer to the smoke, haze, and dirt in the air. The widespread use of bituminous coal by industry and for winter heating causes a pall of smoke and fog which is the nightmare of the city smoke abatement commission. At times this "smog" obscures the sun. Consequently, outdoor air is anything but "fresh air."

This condition causes a tremendous cost of cleaning and upkeep in both commercial and residential buildings, aside from the obvious discomfort and annoyance. In recognition of the need of efficient air cleaning devices for health and to protect the air conditioning equipment, the original design included a self cleaning electrostatic precipitator type of air filter for all of the outside air introduced to the building. In addition, all return air is filtered by standard cleanable and renewable filters, then passed through activated charcoal adsorption canisters to remove odors.

Excess return air, which would normally be exhausted, is used to ventilate the basement machine room. A separate exhaust system removes the ventilation air.

Heating System Needed Replacement

The original two pipe vapor heating system, installed over 20 years ago, required excessive maintenance, was not zoned, and was con-

MANY buildings 15, 20, 25 years old and older are going to have to be air conditioned to be modern; here's a description of how one of them was handled without seriously inconveniencing the occupants. The installation incorporates zone control, electrostatic air cleaning for the outside air, cleanable and renewable filters for the return air, and activated charcoal adsorption for odor removal. . . . Mr. Evans, consulting engineer, served as the consultant for the work, representing the building owner, an insurance company

sidered to have passed its useful life. The necessity of replacing this heating equipment was a further inducement to consider the use of a year around air conditioning system. The air conditioning system —combining individually controlled heating and cooling functions—fulfilled the heating requirement at small additional first cost over a summer cooling and dehumidifying installation, and furthermore provided the required zoning.

The building exposures needed three zones for proper control of temperature. Especially during the spring and autumn months, it is not uncommon to find that the southeast and southwest zones will require cooling, while the northwest zone will need a small amount of heating to maintain comfort throughout the building.

Separation of temperature and humidity control makes it possible to provide required conditions in any part of the building the year around. A brief description of the air conditioning equipment will indicate how this is accomplished.

Three Major Components

The complete system consists essentially of three main components:

a) The air cycle, which includes the air treating plant and the air distribution system. (The air handled here is termed, for the sake of clearness, "primary air.")

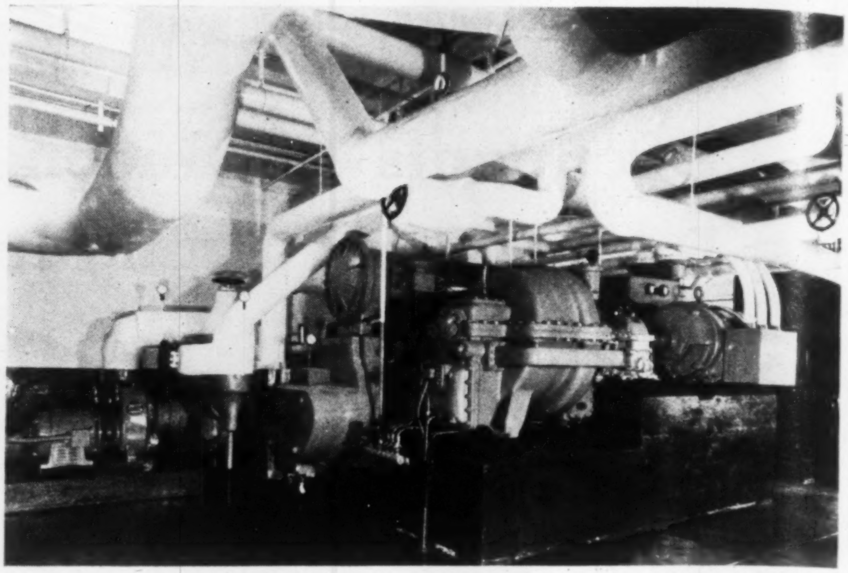
b) The under-the-window units, or high pressure type outlets, with their control, under the windows of the various office spaces.

c) The water cycle, consisting of the water chilling unit, water heating equipment, and the water distribution system.

Air Cycle

Outside air required for ventilation is brought through a rainproof louver at the second floor level, passing through an intake duct to the air handling equipment in the basement. This air is then passed through a preheating coil where, during the heating season, it is heated to such temperature that the proper amount of moisture can be added to maintain the desired relative humidity in the offices.

The air then passes through the self cleaning electrostatic filters where during the entire year all particulate matter is removed. The air then is mixed with return air which has been filtered and deodorized, the mixture passing to the sprayed coil type dehumidifier. After the moisture content of the air has been established by adding or subtracting moisture, it passes through a reheating coil, where during the intermediate and winter seasons the temperature of the air may be tempered as needed.



The water chilling plant has about 90 tons excess capacity to provide for future increase of the building

From here the air passes to the high pressure fan, which forces it into the distribution piping leading to the various room units throughout the building. There are special sound absorbers at the fan discharge to remove noises generated by the fan.

The air distribution system consists of insulated, round, galvanized sheet metal headers in the basement to which are connected the various risers extending upward along the walls of the building. It is interesting to note that the largest riser used is only 8 in. in diameter for a 10 story building. These spiral wound, round tubes distribute the air to the various floors, where at each level the air is taken off through flexible metal tubing and introduced to the units. Because of high pressures used in the conduit system, extreme care was taken to make each joint perfectly airtight, using a special sealing compound.

The Room Units

Each of the room units, or high induction outlets under the windows of the various offices, consists of a sound absorbing plenum, a plate fin water coil that provides both the heating and cooling necessary to maintain the proper temperature in the space, a mixing stack in which the primary air is blended with the room air induced through the water coil, an air valve for setting the proper pressure on the air nozzles or for taking the unit out of service, an emergency drip pan, and a manually operated water control valve that permits the occupant to set the heating or cooling rate as desired.

The control valve knob contains a thermostatically controlled pointer that indicates to the occupant the proper rotation of the knob to obtain either more or less heating or cooling effect.

The ratio of induced or secondary air to primary air is about four to one. With this large quantity of secondary air passing through the water coil in the unit, it is possible to do practically all of the cooling or heating with one air stream, while the primary air from the central station (air cycle) serves to fulfill the ventilation requirements and to maintain proper humidity control. It is this separation of temperature and humidity control that makes it possible to maintain comfortable conditions when the cooling requirement is small. There is always a constant quantity of outside air for ventilation. The total air in circulation in the room is constant regardless of temperature requirements.

Water Cycle

The water chilling plant, primary and secondary water piping, zone water pumps, zone water heaters, and zone controls comprise the water cycle.

The water chilling plant consists of a centrifugal, motor driven refrigerating unit containing compressor, speed increasing gear, wound rotor variable speed motor, refrigerant condenser, and water chiller, with the usual accessories. To provide for future increase of the building, the refrigeration unit has about 90 tons of excess capacity. At the present time, water for condensing purposes is obtained from city mains; however, it is expected that an induced draft cooling tower will be delivered in time for the approaching cooling season.

During the cooling season, water is circulated continuously through the water chiller of the centrifugal unit by a main chilled water pump. This chilled water is pumped through the dehumidifier coils, a portion is returned directly to the water chiller, and the balance is drawn off and circulated by the zone water pumps to the room units. The proportion of primary water and recirculated water in each zone is automatically controlled.

The air conditioning system consists of three main components, the under-the-window room units, or high pressure type outlets (one of which is shown here); the air cycle, including the primary air treating plant and distribution system; and the water cycle, comprising the water chilling unit, water heating equipment, and the water distribution piping system.

Temperatures Carried Under Various Conditions

Outside temperature	30	40	60	70	80	90
Primary air temperature	48	48	83	70	58	52
S. E. zone water, no sun	103	97	65	65	65	65
S. W. zone water, no sun	90	61	50	51	51	52
N. W. zone water, no sun	103	97	65	65	65	65
S. E. zone water, with sun	90	57	48	48	48	50
S. W. zone water, with sun	103	97	65	65	65	65
N. W. zone water, with sun	91	87	55	48	48	48
Reheater in operation	No	No	Yes	Yes	Yes	No

Each zone circuit is equipped with an individual water heater, pump, strainer, and zone piping, with a complete set of controls to maintain the desired zone water temperature. The controls are so arranged that each zone becomes an isolated water circulating system when heating is required; this precaution avoids any possibility of hot water entering the water chiller of the refrigeration machine when heating and cooling may be required in different zones at the same time.

Individual room temperature control of either heating or cooling effect is obtained by variation of the water quantity through the coil of the room unit.

How Operating Engineer Is Guided

The operating engineer is guided by various indicating, recording, and recording-controlling instruments necessary to give him complete control of the equipment. A recording dry and wet bulb thermometer, with bulbs in the outside air stream, forms the basis for setting primary and secondary water temperatures.

A unique "slide rule" was worked out by the Atlanta office of the supplier of the air conditioning equipment, based on the heating or cooling requirement of various zones under different outside conditions. By simply setting the indicator slide at the proper point, as read from the recording thermometer, all controls may be reset to give desired zone conditions. By following the slide rule answers, the operator has been able to keep the building in such condition that there are a minimum of complaints from the occupants. Furthermore, operation cost is kept at a minimum. A few settings of this slide rule are shown in the table, and indicate how it works.

The air conditioning system installed in the Liberty National building is a definite departure from conventional systems put in by many owners in the Birmingham area in the past. It is interesting to note that building owners and managers are becoming more and more conscious of the fact that an air conditioning system must do better than simply cooling or heating the air inside the building. Adequate air cleaning, independent control of temperature and humidity, and perfection in air distribution—while still maintaining complete flexibility—will soon become "musts" on the majority of comfort air conditioning installations.

ENGINEERING COURSE EMPHASIZES LIBERAL ARTS

Aimed to give the State University of Iowa in Iowa City "one of the best engineering courses in the United States," new entrance requirements and a general revision of the entire engineering course have been announced by Dean F. M. Dawson of the college of engineering.

The new engineering requirements, affecting all students entering after June 1, 1947, will permit an expansion in social science and the humanities during the four year engineering course. This trend is in accordance with the recommendations of the American Society for Engineering Education, according to Dean Dawson.

AIR STERILIZATION MAY BECOME "ESSENTIAL"

In the near future it is possible "to foresee people avoiding stores, movies, hotels, etc., that fail to provide protective atmospheres, just as motorists shun drinking water in towns where roadside signs announce that the water is unsafe," according to an article on the common cold by J. D. Ratcliff published in a recent newspaper supplement. It is likewise possible to foresee "business and industry grasping at air purifiers which promise to cut absenteeism."

The article discussed briefly and in popular style the use of glycol vapors and ultraviolet radiation for air sterilization.

Pipe Layout Simplified

Procedure for Field Layout of Equal Diameter Pipe Using Common Tools Is Explained in Detail by B. H. Higgs of The Linde Air Products Co.

LACK OF TEMPLETS, charts, and mathematical formulas need not hinder pipe layout. In such emergencies, welded pipe of equal diameter can be laid out in the field quickly and easily. By using the method described and illustrated here, an operator can lay out, with a few simple tools, branches and Y-connections as well as turns of any angle, radius, and number of segments.

Tools—Fig. 1

The few simple tools required are both readily available and familiar to most operators through almost daily use. A carpenter's square, a bevel protractor with 18 or 24 in. blade, a spirit level, a spring steel wrap around (or tape), a center punch, a hammer, and chalk or soapstone will meet all needs. (A strip of stiff cardboard or sheet tin about 3 in. wide also makes a good wrap around.) For purposes of discussion, the long part of the carpenter's square is referred to as the *blade* and the short part as the *tongue*.

Definitions—Fig. 2

Pipe turns are measured by the number of degrees by which they turn aside from the course set by the adjacent straight section. The angle T is measured between the center lines of the intersecting sections of pipe. Branch connections are measured in angle of turnaway from the main line. For example, a 60 deg branch is so-called because the angle between the center line of the main pipe and the center line of the branch connection meaures 60 deg. Turns are designated by the number of degrees by which they deviate from a straight line.

Quartering the Pipe—Fig. 3

In laying out any joint, the first step is to establish reference points or lines from which additional measurements or markings can be made. This is done by locating a center line and dividing the outside circumference of the pipe into 90 deg segments or quarters. The carpenter's square, level, and chalk are used in the following manner:

Block the pipe so that it will not roll, place the square against it as shown, and then level it by holding the level on the top edge of the blade. Mark the pipe at both points where blade and tongue of the square are in contact with it. These two points are quarter points and are 90 deg apart on the circumference of the pipe. Swing the tongue of the square around to the other side of the pipe and locate the quarter point on that side in the same way. Without moving the pipe, locate three additional quarter points about a foot farther along the pipe. Short lines drawn through these points and parallel to the axis of the pipe provide a center line and two side quarter lines. Locate and mark the bottom quarter line by reference to the side quarter lines.

Simple Miter Turn—Fig. 4

After quartering the pipe, arbitrarily locate the center of the cut (point e) in the general location where the cut is to be made. Use the spring steel wrap around to make a chalk line (ab) completely around the pipe at right angles to the center and quarter lines, thus establishing a base line for further layout work. Any angle formed where this base line and the quarter lines cross will be a right angle and the lines will be perpendicular if distances measured between points are in the ratio of three, four, and five, as shown in Fig. 4.

In measuring, treat the surface of the pipe as if it were a *flat* surface, using a flat steel rule or tape. The rule or tape will lie against the surface without kinks, even though it is forced to follow the contour of the pipe. These angles can also be checked for accuracy by sighting with the square.

Determining Proper Cutback—Figs. 5 and 6

Use the protractor and square to determine the proper amount of cutback for the desired angle of miter turn. Start with the protractor scale set at zero, Fig. 5A, so that the flat surface of the protractor and the blade are parallel. Rotate the blade (Fig. 5B) from the milled face until the scale shows *one-half* the number of degrees of turn to be made in one weld. Lock the blade at this setting.

When the protractor is set (Fig. 5B), place protractor and square together, as shown in Fig. 6, to determine the proper cutback measurement. Be sure that the flat surface of the protractor is flush against the *blade* of the square. The outside radius of the pipe should have been determined during the quartering operation. When square and level are positioned as shown in Fig. 3, the distance from the inside corner of the square to

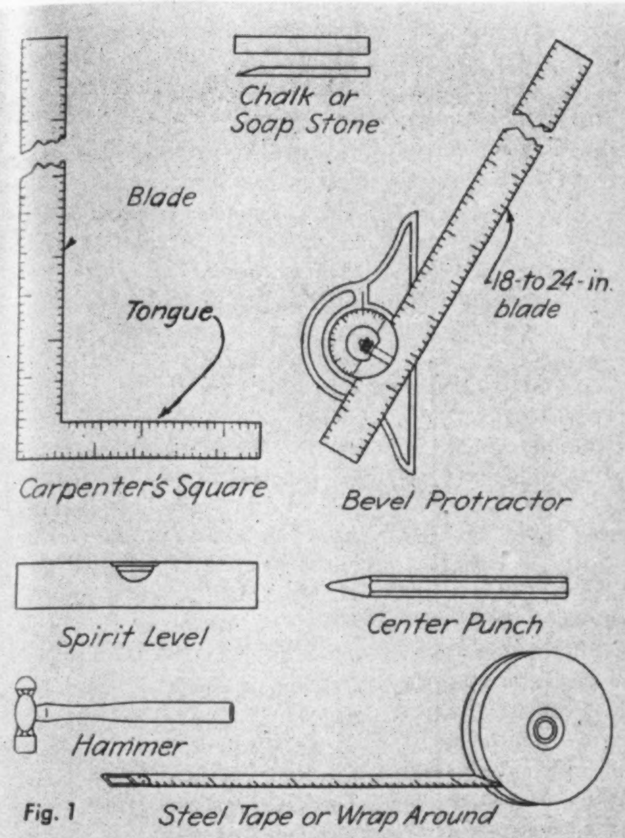
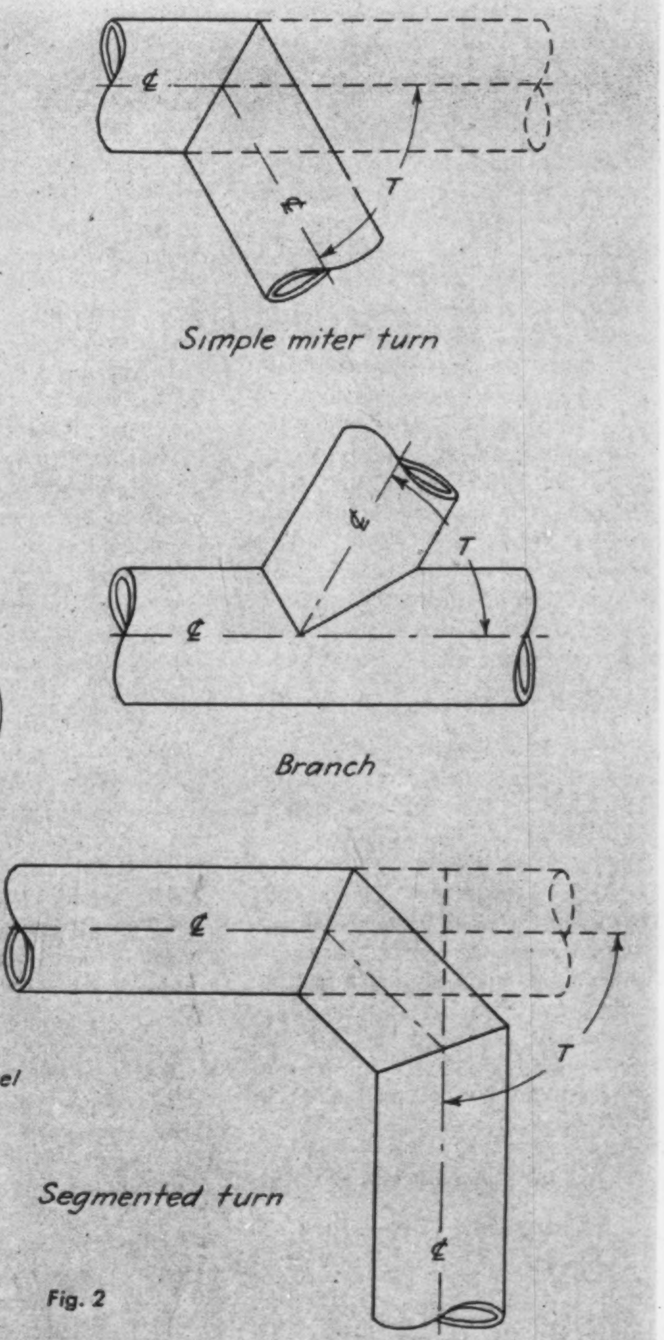

Chalk or Soap Stone
Blade
Tongue
Carpenter's Square
18-to 24-in. blade
Bevel Protractor
Spirit Level
Center Punch
Hammer
Steel Tape or Wrap Around

Fig. 1



Simple miter turn

Branch

Segmented turn

Fig. 2

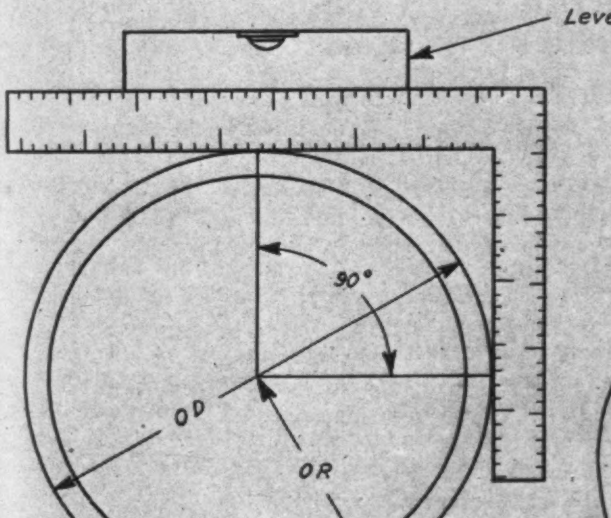

Level
90°
OD
OR

Fig. 3

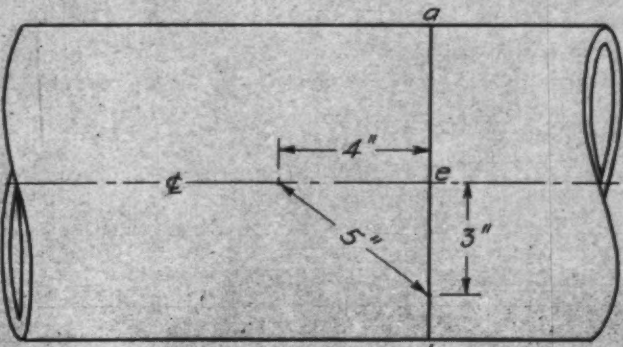


Fig. 4

the point where the blade or tongue crosses a quarter line is equal to the outside radius of the pipe.

Marking Cutback Measurement Fig. 7

Having obtained the cutback measurement (Fig. 6), mark it off from line *ab* along the center line on the top of the pipe. This is point *c* in Fig 7. From the opposite side of line *ab*, measure off the same cutback distance along the bottom quarter line and mark point *d*. Make several center punch marks on each side of line *ab* along the two side quarter lines as shown. These marks make it easier to align the pipe for welding after the joint is cut. Point *f* and point *e* (on the opposite side of the pipe), where line *ab* and the two side quarter lines intersect, are located at the common center of the line of cut.

Mark for Miter Cut—Fig. 8

Hold the spring steel wrap around at points *e* and *f* and pull the loop to the cutback point *c*, as shown in Fig. 8. Then draw a chalk line over the top half of the pipe, connecting points *e* and *f* through the first cutback point *c*. Do not allow the wrap around to twist, and hold the chalk at right angles to it while marking the pipe. Then roll the pipe one-half turn and mark a chalk line in the same way around the bottom half of the pipe through points *e*, *d*, and *f*. The completed line *ecdf* is the mark for making the unbeveled miter cut.

Cutting the Pipe—Fig. 9

While cutting along the line established in Fig. 8, hold the blowpipe as shown in Fig. 9. The correct angle for the blowpipe head is the same as that for the blade of a saw in sawing a wooden round at an angle. This will assure making the entire cut in the plane of the mark. Then bevel the two cut ends for welding, rotate one pipe section 180 deg, and line up points *e* and *f* by means of the center punch marks previously made. Weld the two sections together to complete the miter joint.

Segmented Turn—Fig. 10

A bend consisting of three or more pieces is fabricated by welding one or more short sections (segments) of pipe between the main sections (tangents) of the line. Each segment has a miter cut at each end, and each cut accomplishes an equal part of the total number of degrees of turn. Layout is essentially the same as for a series of miter turns.

After quartering the main sections and the pipe to be used for the segments (Fig. 3), determine a starting point for the turn. To do this, set the protractor (Fig. 5B) for *one-half* the *total* number of degrees of turn desired. Then use the protractor and square as shown in Fig. 6, this time crossing the protractor blade over the measurement corresponding to the desired *radius of turn*, as indicated by point *b*, Fig. 10[*]. Point *c*, on the tongue of the square, is the intersection of the pipe center lines. Point *a*, at the outside corner of the square, is the geometric starting point of the turn, or the point where a true 90 deg pipe bend would begin. Read distance *ac* on the tongue of the square, and mark off point *a* on the center line of the pipe for reference. It is the point from which the first miter cut is located, regardless of the number of welds or segments in the turn.

Next, divide the total number of degrees of turn by *twice* the desired number of welds. Set and lock the protractor blade at the degree setting corresponding to this figure. For example: A 90 deg turn with three welds will require a protractor setting of 15 deg because 90 (total number of deg of turn) divided by six (two times the three welds desired) equals 15.

Use protractor and square as shown in Fig. 6, again crossing the blade of the square at the measurement of the *radius of turn*. The mark at which the protractor blade now crosses the tongue of the square indicates the correct distance from the start of the desired turn to the center of the first cut. Lay off this distance on the center line from point *a*, mark it (point *d*), and make a square line around the circumference of the pipe at this point.

With the protractor at the same setting as before, follow exactly the procedures outlined in Figs. 6, 7, 8, and 9 to complete the segmented turn. The proper length of each segment, measured along center line *de*, is twice the distance between point *a* (starting point of the turn) and point *d* (center of cut). Cutback distance for both ends of each segment is the same as for the first miter cut at the end of the main line, but the cutback angles are reversed. Parallel cutback angles are used to form an offset instead of a turn.

Branch Connection—Fig. 11

Branch-to-header connections at angles of 45 to 90 deg can be fabricated in equal diameter pipe by following the procedure illustrated here. (Angles less than 45 deg can be made but practical limitation is imposed by difficulty of welding the crotch section.) First quarter both sections of pipe, as shown in Fig. 3. Then locate the center line of intersection (point *b*) on the header and draw line *fg* around the pipe at this point. Set and lock the protractor at one-half the total number of degrees of turnaway from the header. Following the procedure shown in Fig. 6, determine the *first* cutback measurement on the *tongue* of the square. Measure off this distance along the center line of the header from line *fg* and mark point *a*. As described in Fig. 8, join point *a* with the points of intersection of line *fg* and the two side quarter lines to outline the first cut.

With the same protractor setting, determine the second cutback measurement for the header.[†] Use protractor and square as before, sliding the protractor along the blade of the square until its blade crosses the outside radius measurement of the pipe on the *tongue* of the square. Then read the *second* cutback measurement on the *blade* of the square. Mark off this distance (point *c*) on the center line of the header on the

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[*] Note: If the desired radius of turn is too long to be measured directly on the carpenter's square, take any convenient fraction of the radius and let the protractor blade cross this fractional measurement on the blade of the square. Then multiply the reading shown on the tongue of the square by the same figure originally divided into the full radius. As an example: for a 45 in. radius of turn, place the protractor blade at 15 in. (1/3 of full radius) on the blade of the square and multiply by three the direct reading indicated on the tongue of the square. This procedure will give the same result as a direct reading from a full measurement setting.

[†] Note: Do not change the protractor setting in determining the two cutback measurements. One setting gives both measurements by crossing the pipe radius, first on the blade and then on the tongue of the square.

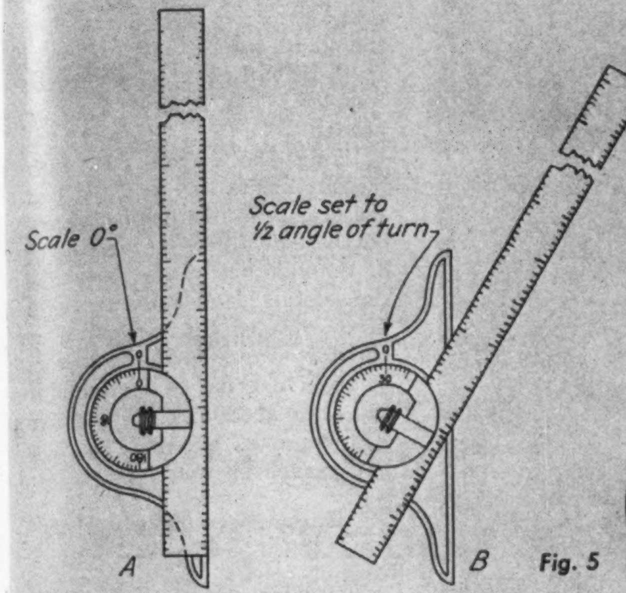

Scale 0°
Scale set to ½ angle of turn
A
B

Fig. 5

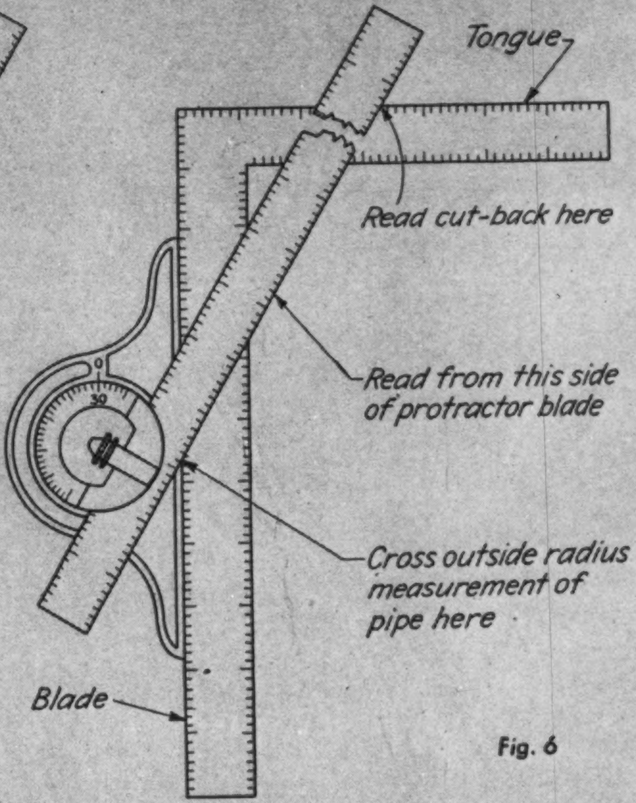

Tongue
Read cut-back here
Read from this side of protractor blade
Cross outside radius measurement of pipe here
Blade

Fig. 6

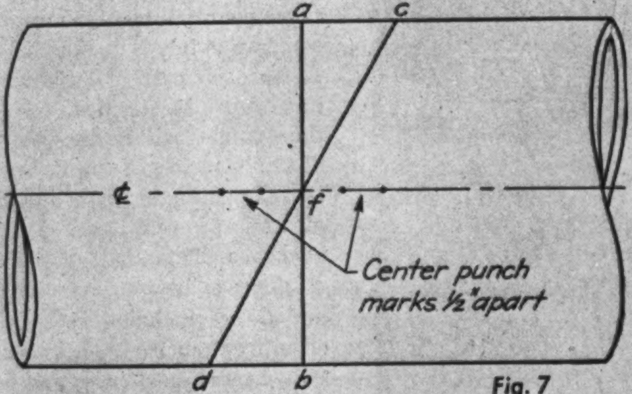

a
c
℄
f
Center punch marks ½" apart
d
b

Fig. 7

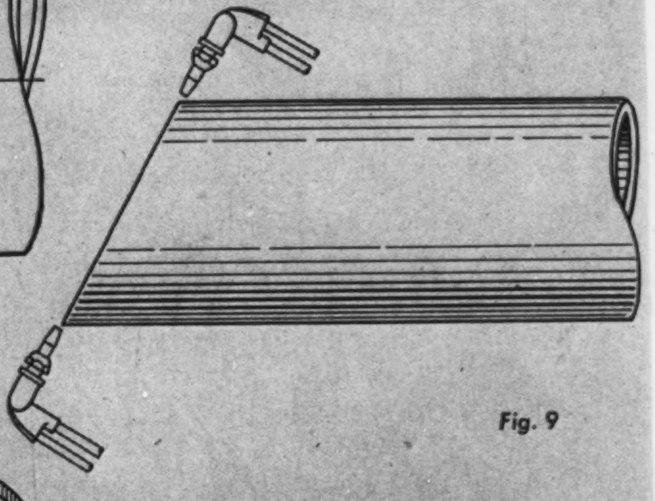


Fig. 9

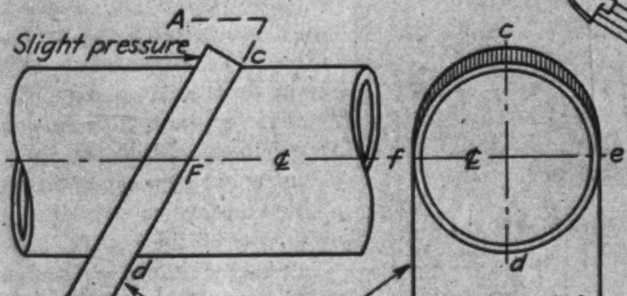

A
Slight pressure
c
F
℄
f
d
Wrap around
A
c
℄
e
d
Section A-A

Fig. 8

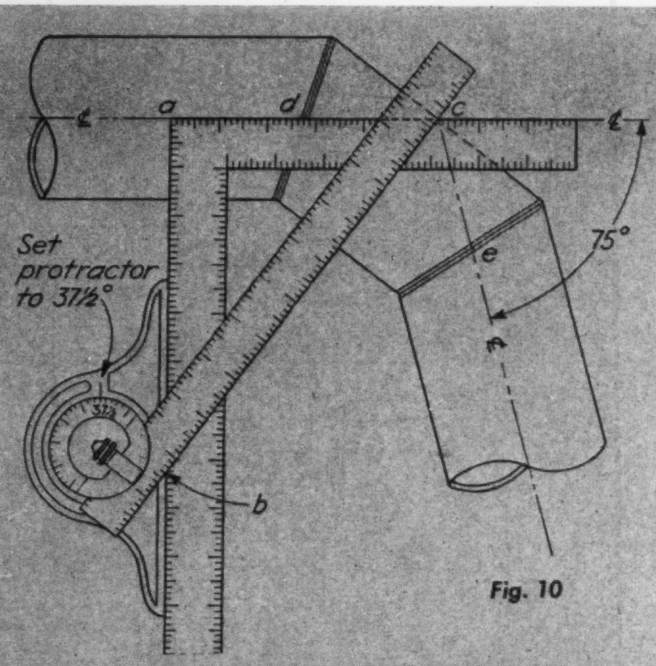


Fig. 10

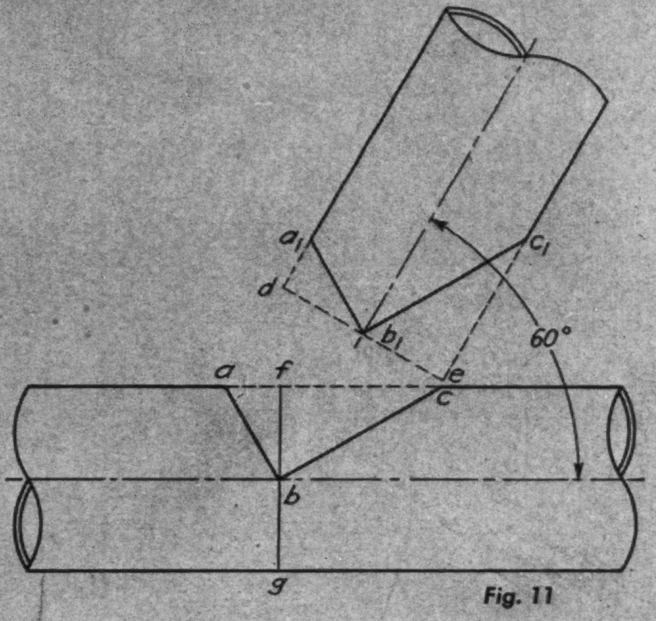


Fig. 11

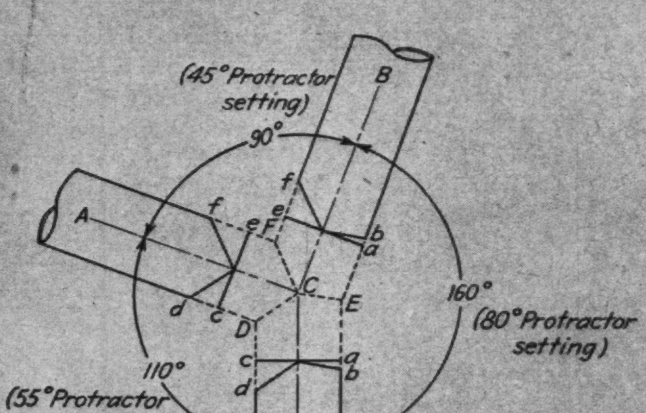


Fig. 12

opposite side of line *fg*. Then draw a chalk line through point *c*, connecting the two side quarter lines at the points where they intersect line *fg*. This outlines the second cut and completes the marking of the header.

Using the same two cutback measurements, lay out the end of the branch in like manner, marking off these distances on *opposite* sides of the pipe but on the *same* side of the established circumferential line. If the branch end is square, make cutback measurements from it rather than marking in a circumferential line. Make all cuts as shown in Fig. 9, bevel, and join the header and branch by welding.

Three Piece Y-Connection —Fig. 12

The entire procedure for fabrication of an equal diameter, three piece Y-connection is based on individual operations already described. First quarter the ends of the three pieces of pipe, as shown in Fig. 3, and apply circumferential lines as described for Fig. 4.

When the pieces are welded together to form the Y, there will be three center lines radiating from a common point. The open angles between each pair of adjacent center lines must be decided, for each of these angles will be the angle of one of the branches of the Y. As shown, these open angles determine the angles of adjoining sides of adjacent branches. Thus, half of the number of degrees between center lines *B* and *G* are included in each of the adjoining cutbacks between these two branches. The same is true with respect to the other angles and cutbacks between center lines *B* and *A*, and *G* and *A*. Moreover, each piece of pipe must have a combination of two angles cut on the end.

To determine the amount of cutback to form an angle of the Y, set the protractor at *one-half the open angle* between adjacent branch center lines. Place the protractor on the square, crossing the outside radius measurement of the pipe on the *tongue* of the square, and read the cutback distance on the *blade* of the square. Mark off this distance on one side quarter line on each of the two pieces that are to be joined. Then mark the cutback lines as described for Fig. 8. Repeat this procedure for the other two angles of the Y, taking care to combine the proper cutbacks on each pipe end. Three settings of the protractor determine all cutbacks.

An alternative method for determining each cutback is to treat two adjacent branches as a simple miter turn. Subtract the number of degrees of open angle between center lines from 180 deg and set the protractor at *one-half of the difference.* Using the protractor and square as before, cross the outside radius measurement of the pipe on the *blade* of the square, and read the cutback measurement on the *tongue.* Mark one side of each adjoining pipe section. Repeat for the other two branches, taking care to combine the proper cutbacks on each pipe end. Set the protractor for each open angle of the Y connection.

Table 1—Computations and Measurements for Layout Shown in Fig. 12.

	ACB	ACG	BCG
Open angles between center lines..............	90 deg	110 deg	160 deg
Protractor setting (half of each angle).....	45 deg	55 deg	80 deg
Cutback	6⅜ in.	4½ in.	1⅛ in.
Center lines..............	A	B	G
Paired cutback measurements, in.	fe=6⅜ cd=4½	ab=1⅛ fe=6⅜	ab=1⅛ cd=4½

Computations and measurements for the layout shown in Fig. 12 are given in Table 1. Pipe diameter is 12 in., with an outside radius of 6⅜ in.

Condensation in Walls, Vapor Barriers Studied

Some of the results of recent tests on condensation in walls and the effects of vapor barriers conducted by the National Bureau of Standards indicate the following:

1) A laboratory provides a practical means for testing wall constructions for condensation under selected conditions of temperature and humidity.

2) A good edge seal for paper or metal foil barriers, when used in frame walls to reduce condensation, is very important.

3) Condensation can be expected in a frame wall insulated with 3⅝ in. of fibrous material if the air on the warm side is maintained at 70 F and 30 per cent relative humidity and the air on the cold side is about 0 F. However, condensation can be avoided by the use of a vapor barrier with a permeability of 3.8 grams or less per sq meter per 24 hr when exposed at 73 F to dry air on one side and 50 per cent relative humidity on the other.

Building Materials and Structures Report BMS 106, issued by the National Bureau of Standards and prepared by R. S. Dill and H. V. Cottony, contains the results of a laboratory investigation of eight different arrangements of insulation and vapor seals in frame wall structures.

The apparatus consisted essentially of a cold box cooled by a refrigerating coil and a hot box heated electrically enclosing a trough or vat containing a salt solution by means of which the humidity in the hot box was controlled. Wall specimens of conventional materials and construction were installed with one side exposed to warm humidified air and the other side exposed to relatively cold air. A saturated solution of calcium chloride hexahydrate was used in the humidifying pan, and the humidity in the hot box was measured by means of a dew point hygrometer. The permeabilities of materials used as vapor barriers (untreated kraft paper, asphalt-saturated kraft paper, and aluminum foil) were determined by the official method of the Technical Association of the Pulp and Paper Industry. Five copper-constantan thermocouples were used on each inside and outside surface of sheathing, siding, and plaster, and in addition, five thermocouples were used in the cold box for measuring air temperature and four thermocouples were similarly used in the hot box. Electric hygrometers, calibrated before and after each run, were used to determine moisture in stud spaces.

Paper covered copies of this nine page report may be obtained from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. The price is 10 cents.

Issues New Book on Methods of Analyzing Metals

The 1946 Book of ASTM Methods of Chemical Analysis of Metals, which replaces the earlier 1943 edition, gives in their latest form the 35 extensive standards developed by the ASTM committees concerned with the analyzing of metals and their alloys. The greatly expanded volume—412 pages compared with the 1943 edition of 330 pages—includes not only modernized versions of the various older methods widely used throughout industry, but it includes several of the newer photometric methods and also provides spectrochemical methods of analysis for certain materials and elements.

There are recommended practices covering apparatus and reagents and photometric methods. The extensive methods of sampling and chemical analysis of steel, cast iron, wrought iron, ferro alloys, etc., are included, and a considerable portion of the new volume is devoted to nonferrous metals, including sampling, chemical analysis, and photometric methods covering aluminum, magnesium, copper, lead, lead and tin base alloys, solders, zinc and nickel. Of the 35 standards seven pertain to photometric methods and five involve spectrochemical procedures. Sixteen of the 35 methods carry 1946 designations indicating they were either new last year or have been revised.

These methods are intended for general use in the buying and selling of materials according to specifications.

Copies of this publication, 6 by 9 in. page size, in blue cloth binding, can be obtained from the American Society for Testing Materials, 1916 Race St., Philadelphia, Pa., at $4.50 per copy.

GREATER INTEREST IN BRITAIN

High Pressure Hot Water Heating

Applications, Advantages of High Pressure Hot Water Scheme Reviewed by Cyril Tasker

THERE APPEARS TO BE much greater interest in the application of high pressure hot water to space and process heating problems in Britain than there is in America, and a recent paper by F. R. L. White, in Vol. 14, No. 137, of the Journal of the Institution of Heating and Ventilating Engineers discusses some of these applications, many of which were made in large war factories.

After discussing the basic principles underlying high pressure hot water heating, the author suggests that there has been in the past a considerable amount of confused thinking on the comparative merits of steam and high pressure hot water as applied to space heating problems. Much of this, he feels, has been due to the failure to appreciate the true value and practical application of latent heat, which has been looked upon as a primary factor in the design of heating plants, whereas it is—in actual fact—a secondary one.

Applications

In discussing applications, the author points out the desirability of preventing condensation and using the hot water under pressure as the heat conveying medium. This is accomplished by terminating the flow and return connections to the boiler below the water level, so that the water circulates through the pipe system under the pressure created within the steam space. He points out that considerable care is necessary in deciding upon the positioning and general arrangement of the flow and return connections on the boiler shell, particularly the flow connection, and gives some detailed precautions that experience has shown to be important. With large systems, where two or more large boilers are working in battery, great care and patience are necessary when an additional boiler is brought into use, in order to prevent violent disturbances within the boilers and pipe lines.

There is a definite relationship between the pressure and the temperature of hot water in an enclosed system which may be thrown out of balance in two ways: the pressure may be reduced when the temperature is constant, and the temperature may be reduced when the pressure is constant. The layout for the piping system for high pressure hot water installations needs great care, therefore, if rumblings and hammerings are to be prevented.

The author suggests that the layout of the pipe lines for such systems offers the designer much more freedom of action than is practicable with steam installations.

Mr. White states that, in his opinion, "it is unwise to attempt to combine direct steam supply with high pressure hot water from the same boiler plant, and such an arrangement, whilst not impracticable, should be deprecated, mainly from the viewpoint of operational difficulties which are likely to arise.

Satisfying Steam Requirements

"There are very few heating and process problems to which high pressure hot water cannot be successfully adapted and the proportion of steam for direct process use in any industrial establishment need be very small indeed.

"Under these circumstances, any such steam required can be quite satisfactorily produced by a heat exchanger operated from the high pressure hot water mains at or near to point of use. Such an example may be a works canteen where steam is required for the cooking plant, and this is a very simple, clean and easily handled piece of equipment."

He gives details of one such installation providing 750 lb per hr of steam and continues, "Practically all other processes requiring heat can be dealt with by indirect methods, using high pressure hot water as the prime heating medium. For instance, vats or boiling pans may be heated by coils. Drying stoves or chambers may be heated either by coils or by plenum plant with the heaters connected to the high pressure hot water system. Hot water for domestic purposes can be produced through the medium of a calorifier, and so on. There is no end to the scope for exercising one's ingenuity in this connection.

"For all process jobs it is usual to provide a separate set of mains to operate during summer and winter, and to connect canteen services and hot water supply services to these mains."

He concludes by saying, "One must, of course, keep an open mind when discussing steam and high pressure hot water from the point of view of comparative merit, but

ON THESE PAGES, Cyril Tasker, Director of Research of the American Society of Heating and Ventilating Engineers, reviews recently published British material on heating that is of particular interest to American engineers. Such comments give a fresh viewpoint, and often an opportunity "to see ourselves as others see us"

there are very few heating and/or process problems which cannot safely and efficiently be solved by the use of high pressure hot water and it would seem that high pressure hot water has a very fair future, provided it is handled by capable and experienced engineers."

Advantages of High Pressure Hot Water

The second edition of the book Heating and Air Conditioning of Buildings, by Oscar Faber and J. R. Kell, published by the Architectural Press, London, and reviewed in the ASHVE Journal Section of the August 1944 issue of HPAC, page 506, devotes a fairly long chapter to heating by high pressure hot water. The authors say that the system was developed by continental engineers and has been adopted extensively in England, particularly for large industrial installations. They claim many advantages over the use of steam for heating. The principal ones are: mains can be run almost regardless of level and for long distances if well lagged, the amount of heat distributed can be adjusted within fine limits, there are no steam traps or similar accessories to maintain, and corrosion troubles in the piping are very much reduced if not entirely eliminated.

They discuss comparative pipe sizes and show that for all sizes a high pressure hot water system, working at 100 F temperature drop through the apparatus, will deliver approximately as much heat as a steam line at 150 psi. Substantial fuel savings are also claimed for high pressure hot water over steam.

In a large installation the heat is generally utilized in the building by means of convectors, unit heaters, or pipe coils. By the use of a water-water calorifier or heat exchanger, domestic hot water can be obtained as desired, or if necessary the calorifier can be used to supply a low temperature radiator system. The chapter concludes with details of pipe sizing for this type of system.

Heating in the U.S.A.

Cyril Tasker Gives Mission's Comments on Comfort Requirements, Coordinating Research, Heating and Planning, District Heating

DURING THE WINTER of 1944-45 a joint party from the British Ministry of Fuel and Power and the Department of Scientific and Industrial Research spent 12 weeks in the United States and Canada to obtain first-hand knowledge of American developments and practice in heating. Their report, which was used in the formulation of the British government's policy on fuel problems, was recently published under the title, Domestic Heating in America. Copies may be obtained from the British Information Services, 30 Rockefeller Plaza, New York 20, N. Y. The report contains 14 chapters and six appendices, and some of the comments and recommendations made by the members of the party may be of interest to American heating engineers.

The report begins by giving a general picture of the climate, fuel supply, methods of heating, appliances in use, and research work in progress in the United States, and points out not only the wide variation throughout the country, but the difference between the climatic conditions encountered in the more densely populated parts of the United States and those found in England.

The authors remark that in America the open fire is retained only for its decorative value, and there is no demand for it or for any alternative source of *high temperature* radiant heat. They report visiting certain small houses in which they found two chimneys and were told that one was for "the heating appliance" and the other for "the open fireplace." They ask whether the comparatively large amount of sunshine found in America the year 'round has any bearing on this lack of demand for artificial radiation as compared with England.

Comfort Requirements

These investigators reported that whereas the majority of people, when questioned, said they liked temperatures of 70 to 72 F, with slightly cooler bedrooms, they found that, in fact, temperatures around 74 to 76 F were generally maintained. This they believed to be caused partly by the desire to offset radiation to the cold exterior walls and windows, and partly by the fact that, in contradistinction to English habits, the normal indoor dress is more or less the same in summer and winter. "There may be," they say, "something in the fact that because there is usually no visible source of heat, there is a tendency to require a high temperature before people are convinced that they are really warm unless they can see a thermometer, whereas in England with an open fire it may be that we are more easily convinced that we are warm by the actual sight of the flames or glowing fire."

"It seems to be recognized," the report states, "that neither in America nor Britain have fully satisfactory conclusions been reached on the actual requirements for optimum comfort, and it is therefore clear that a further united effort by physiologists, physicists, and engineers of the two countries should produce valuable results."

In the part of the report dealing with the development of panel heating in America is the following paragraph:

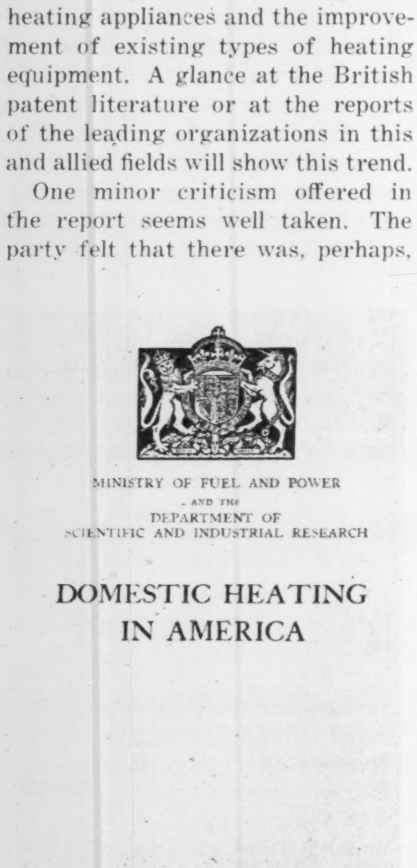
"In the few examples we saw we did not find that dry bulb temperatures were kept lower than in houses with other forms of heating. It was very interesting, however, to find that everyone was convinced that with floor panel heating a floor surface temperature of 80 F was perfectly comfortable and many people were satisfied that floor tem peratures up to 85 F were satisfactory. In England a floor space surface temperature of about 70 F or a maximum of 75 F has been regarded as the limit permissible for comfort and, therefore, further investigation seems to be required, since with an increase in permissible floor surface temperature it would be possible to use floor heating alone in cases where this would be impossible with a 70 F surface temperature limit."

Research Work Needs Coordination

While very impressed with the total amount of research work in progress, it appeared to these visitors that there was a great concentration of effort on problems of immediate practical application. Much of the work going on was directly sponsored by trade interests, they reported, and more work was being done on methods of heating than on actual heating appliances. This, your reviewer feels, is a natural reaction since much of the work being done in England is slanted toward the development of new types of heating appliances and the improvement of existing types of heating equipment. A glance at the British patent literature or at the reports of the leading organizations in this and allied fields will show this trend.

One minor criticism offered in the report seems well taken. The party felt that there was, perhaps, some lack of a central organization to coordinate the very large mass of work in progress in the many laboratories scattered throughout the United States. There is no doubt in this reviewer's mind that we sadly lack this coordination and that an improvement is not only desirable but would be economical. Such coordination is by no means simple and can appear to be costly, but in the long run it might be much cheaper than the present condition.

Discussing the testing of appliances and the development of standards, these visitors point out that numerous associations and institutions in America are busy developing standard specifications. Individually, they say, these specifications are often excellent, but the lack of a single authority to deal with the preparation of all standards results in a certain amount of confusion. It sometimes takes a visitor to show us our shortcomings!


MINISTRY OF FUEL AND POWER
- AND THE
DEPARTMENT OF
SCIENTIFIC AND INDUSTRIAL RESEARCH

DOMESTIC HEATING
IN AMERICA

LONDON : HIS MAJESTY'S STATIONERY OFFICE
1946
Price 3s. 0d. net

The report was used in the formulation of government policy on fuel problems

Heating and House Planning

The members of this party were interested in the wide difference between the normal house plan in the United States and the normal prewar house plan in England, and discussed this point frequently on their tour. They finally drew the conclusion that the open type of house plan now common in America was a consequence of the development of central heating rather than the reverse being true.

The relatively small air change normally found in houses in America—low, at least, in comparison with British ideas on ventilation—impressed these investigators very much. They point out that in spite of this low air change the houses they visited did not appear to be "stuffy" even if too warm for comfort. There is a good deal of confusion between "overheating" and "stuffiness," which is another argument for more studies on the factors that influence comfort and satisfaction.

The report forms interesting reading and contains statistics on American heating methods, etc., which are often difficult to find because they are scattered throughout a large number of different publications.

District Heating

The party whose report has been reviewed above did not study any district heating schemes during their tour. However, in the Final Report of the New Towns Committee, published in England in July 1946 under the Ministry of Town and Country Planning, there are some interesting comments in an appendix on the possible application of district heating in Britain. To quote:

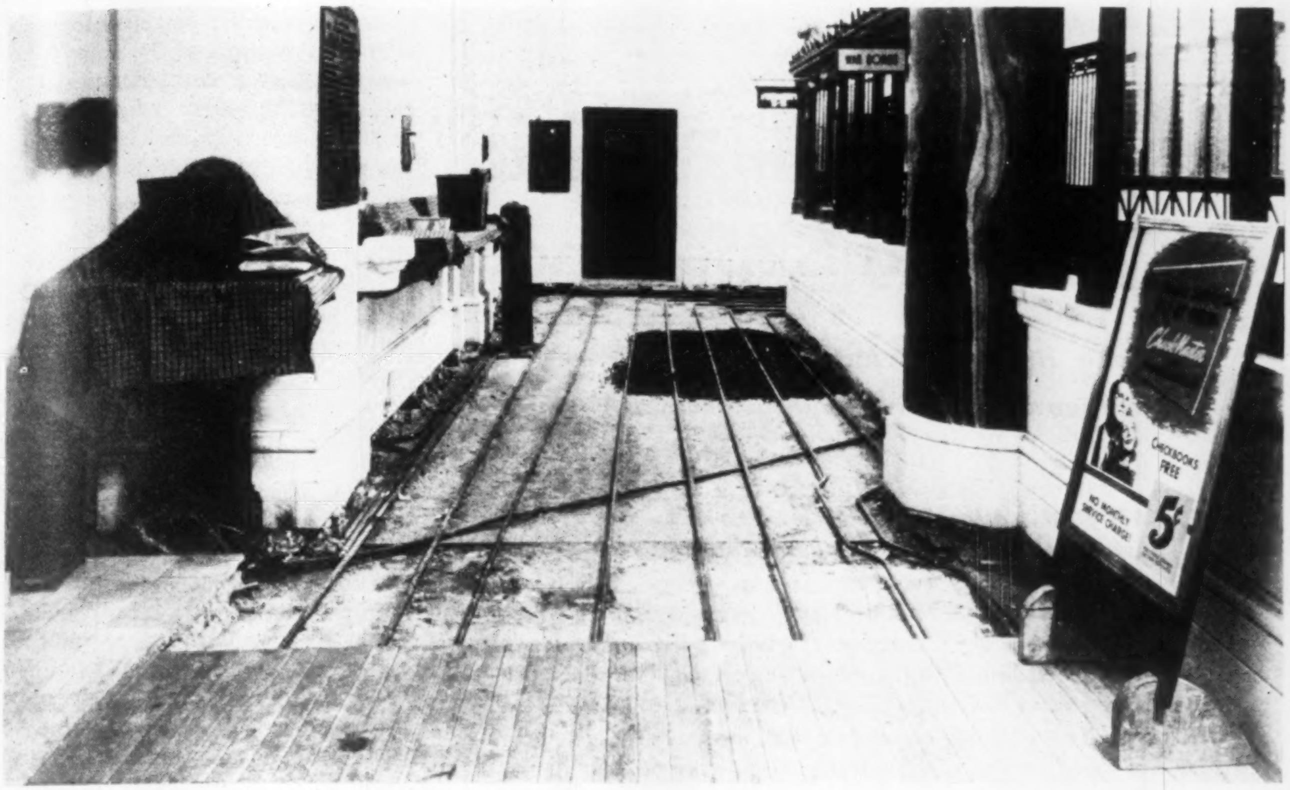
"Hot water is probably more generally suited to British conditions than steam, the principal reason being that a hot water installation is more readily controllable to suit the rapid variations of external temperature of this country. In small district schemes, for groups of a few hundred houses, it may be desirable to use low pressure hot water mains, with the buildings directly connected. In a scheme for a town of 20,000-60,000, however, it might well be technically and economically preferable to use high pressure hot water, to obtain the advantage of flow temperatures up to 275 F, or even higher using calorifiers or other devices for connecting individual buildings. With a high pressure system, smaller mains can be used and heat losses in transmission reduced.

"The capital cost of district heating is high compared with other services, even when structural economies due to the elimination of chimneys are taken into account. The high efficiency of operation of the large plant, however, enables heat to be delivered at a price per therm which compares favorably with heat produced by most other methods."

A comprehensive report on the possibilities of the application of district heating in Britain will be published shortly, it is understood.

* * * * *

INTERNATIONAL "INCIDENT"—During discussion of one of the papers at the ASHVE's annual meeting last month, an American engineer remarked that in his opinion none of the heating installations abroad were any good at all. A visiting Englishman retaliated by expressing the same view about American beer. It all added life to a technical afternoon.



ABOVE

The temporary wood flooring used during the day was removed in sections at night as workmen tore up the old bank floor, laid the pipe on the structural slab, put down a gravel fill, poured a $1\frac{1}{2}$ in. concrete setting base, and finished the floor with tile

Remodels Bank Heating System Without Interrupting Service

THE FIRST BANK in the U. S. to be remodeled for radiant heating is open for business—and, in fact, remained open throughout the six week remodeling period, although the work involved rebuilding of the floor and the laying of some 3000 lineal feet of pipe coils in a floor area of about 3500 sq ft.

Temporary wood flooring, on which patrons and employees of the Union National Bank of Pittsburgh walked by day, was removed in sections at night as workmen tore up the old bank floor, laid the wrought iron pipe on the structural slab, put down a gravel fill, poured a $1\frac{1}{2}$ in. concrete setting base, and finished the new floor with lava tile slabs. The work was done entirely in 7-hr night shifts, so that the bank could continue to serve its patrons without interruption.

Hot water is supplied by a heat exchanger fed with steam piped in from a commercial steam heating plant that serves much of Pittsburgh's "Golden Triangle" downtown business area. Water temperature regulates the flow of steam to the heat exchanger, and flow of water forced through the piping by a rotary pump is governed by a thermostat.

A new combination valve and vent for use with radiant heating systems also made its debut with this installation. Manually operated, the valve is described as having a minimum of moving parts. It is set into the floor over the pipe, and the stem of hollow brass tubing cut off to fit floor thickness. A regular valve handle may be used to regulate water flow through the coil, or a circular geared floor plate provided with the valve may be employed.

Venting is accomplished by a slot cut in the top of the pipe, over which the valve cap is screwed; the solid valve stem, integral with the butterfly, is drilled to permit venting through the hollow variable-length removable stem opening beneath the floor plate. Air is prevented from escaping, except through the hollow stem, by a neoprene seal.

Because of the unusual floor arrangement of the bank, in front of and behind tellers' cages, and the heating requirements peculiar to such a structure, the 3200 ft of pipe used varied from $\frac{1}{2}$ to 2 in. in size, the larger diameters of course for supply and return mains. Near outside walls the pipe was laid on 12 in. centers; at other points the pipe runs are usually 18 in. apart but this varies at a number of points where floor layout dictated a change.

Alexander Dzubay, Pittsburgh, mechanical engineer, made the radiant heating system plan. Installation was done by the Iron City Heating Co. F. Swem, reg. architect, made the plans for the remodeling and supervised it.

PRACTICAL PIPING PROBLEMS

Design Engineer Reports on Operating Experience

John H. Clarke, Marine Engineer, Writes of Pumping, Piping Troubles

DIRECT, FIRST-HAND experience on how designs perform in service, how the equipment is actually operated, and what troubles are encountered were Mr. Clarke's objectives when he (a design engineer by training and profession) shipped on a tanker as junior third assistant engineer. The experience he got was most illuminating, and he reports on some of the piping and pumping difficulties here, continuing his tale from our January issue . . . His comments and observations are of interest not only in connection with marine work, for many of them apply to mechanical equipment in plants and buildings as well . . . His seagoing phase completed, the author is now a design engineer with the Standard Oil Co. of Indiana

THE BILGES WERE quite dirty on the ship, and this gave us considerable trouble in trying to pump them out. The bilge pumps were not in good shape, or at least the systems weren't, because it was difficult to obtain more than a few inches of vacuum on the pump suctions. Therefore, it was often necessary to operate the fire pumps in conjunction with the bilge pumps to make any headway.

Pump Troubles

The ship began to roll and pitch a bit after about two days at sea as we headed into a severe storm. Our shaft stern tube gland was none too good, and with plugged up bilge suctions, we began to get behind on our pumping. The water in the shaft alley was up about 3 ft, when we got quite a setback. The throttle valve gland on the starboard main feed pump turbine had been leaking seriously. This pump was alongside the aft fire pump. As the steam leak got worse, the pump room gradually became filled with steam, soaking the equipment with condensation. The fire pump motor finally gave up the struggle and burned out with a mighty "whopp." That not only stymied the bilge pumping, but also deprived us of our cooling water service to the various bearings and for the flushing or sanitary systems.

Ordinarily the cooling and flushing water was provided by one of two pumps, the salt water service or the sanitary pump. But both of these pumps were defective and only delivering about 50 per cent of normal pressure, so the aft fire pump had been used in their stead. In this emergency, it was necessary to start the two pumps and operate them in parallel in order to get as much pressure as possible. When the aft fire pump burned out, we promptly "locked the barn after the horse was stolen," and proceeded to change over to the starboard main feed pump.

The blown out gasket on this pump had been temporarily repaired for the emergency by pounding copper wire into the joint. The day after burning out the aft fire pump, we nearly burned out the forward one; the trouble was caused by a well meaning but misinformed oiler who overpacked the pump ball bearings with grease. Fortunately, the pump was shut down in time and later investigation showed that the bearings were undamaged. But in the meantime, the pump had been out of service for several days, and the water in the shaft alley was over the 4 ft mark and within about 6 in. of the level where it would enter and damage the shaft bearings.

Governor Valve Inoperative

Our troubles were still far from over. In changing over to the starboard main feed pump, we started off on another chain of them—probably induced by the fact that the governor valve was inoperative and that the steam to the pump and the boiler feed were being controlled by hand. The immediate cause was probably that the turbine constant speed governor was set too close to the tripping speed. This is the governor provided on the turbine, not to be confused with the previously mentioned steam governing valve. In any case, the pump started tripping out frequently at the most embarrassing moments, and emergency stops were still one of the more prominent items on the agenda.

Ventilation a Problem

All during the last two days of the ocean leg of the trip we were provided with additional entertainment by a typical, howling, Cape Hatteras storm. It is now obvious to the author why that place has such an unfavorable reputation among seafaring regulars. The seas were sizable and breaking all over the ship. The spray, carried with driving force by the gale and combined with the occasional torrential downpours of the storm, gave us quite a problem.

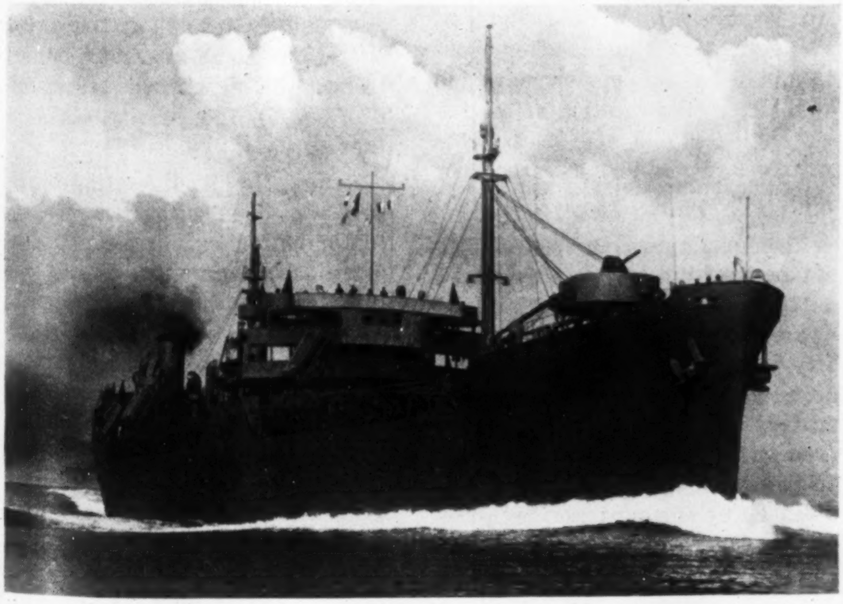
Like much of the rest of the design, the machinery space ventilation was a rather unfortunate combination of the old and the new, employing cowl ventilators for supply and exhaust to the weather and using fixed exhaust inlets and supply outlets in the machinery space. Only two of these outlets—those in front of the switchboard port and starboard — were provided with dampers. Two grating openings were provided over the boiler room to exhaust the hot air to the outside, hinged covers forming the only weather protection. With this setup, we were nearly deluged in the boiler and generator rooms before we could get the situation under control. The cowls had to be turned away from the weather—which is a good trick if you can do it in a storm in which the wind is changing direction continually, and on a ship which is yawing considerably as it plows through the waves. Some poor soul had to go out into the weather to close the covers to the boiler room gratings.

The outlet dampers for the ducts at the main switchboard were closed but this deprived us of much needed air. We could have left the dampers partly open, but they were installed at the opening of the outlet following a 45 deg bend, and the dampers were of the single bladed butterfly type. Consequently, when even slightly open, they deflected the water and spray coming down the duct onto the switchboard. Two fixed outlets were provided at the aft end of the generator flat, one of which blew directly into the end of one of the auxiliary generators. Because no damper was provided, it was necessary to put a canvas cover over the end of the generator to keep the spray out. This is a good example of a case where proper consideration of the ventilation requirements would have saved considerable trouble and possible damage to the equipment and—at the same time—would have provided ventilation for the spaces even during the heavy rain and wind. "All-weather" inlets would have eliminated the rain and practically all of the spray. Adjustable outlets would have permitted a good supply of air without the possibility of entrained spray being blown onto electrical or other equipment where it could cause trouble. (It should be mentioned that the designs of the Maritime Commission's long-range cargo ships incorporate good ventilation, and weather inlets are provided in all cases.)

"A Few Unhappy Lurches"

During the storm the ship was rolling anywhere from 5 to 15 deg on the average, with a few unhappy lurches as high as 25 deg. Insofar as possible, everything was tied down. But now and then something would break loose and slide across the ship with a sound like an avalanche. We had things fairly well under control in the machinery spaces, although the severe rolling wasn't making the hand feeding of the boilers any easier. But in the galley they were really busy. The conclusion has been reached that this department never learns from experience—certainly not the dish polishing ("pearl diving," in the vernacular) division at least, and the mess boys don't do any better. After about every storm where the ship is doing an appreciable amount of rolling, the crockery, catsup, mustard, and items like salt and pepper seem to get spread all over the deck. Mixed in with a foam fire extinguisher that has become unhooked and has given its all, it can be quite a mess to clean up.

A 523 ft, 10,000 hp, 140,000 bbl tanker similar to the ship described in this article



Despite our difficulties, we finally reached the protection of Chesapeake bay. This didn't end them, but we felt that at least this was a more convenient place to have them —and the water was definitely calmer.

We had by this time managed to reduce the water level in the shaft alley, but in order to do so it had been necessary for one of the wipers to climb into the icy water and remove the debris over the bilge suction strainer plates. This consisted mostly of short strands of manila or sisal rope which had somehow gotten in the bilges and spread over a wide area. It was not only necessary to pick up this material, it was necessary to keep it picked up until the bilges could be pumped out. This was a good illustration of why clean bilges are a good thing to maintain. It also illustrated a simple point that most oldtimers already know—that any suction strainer plate handling water with considerable debris and solids should be provided with a "bird cage" or similar device to prevent the suction from being blocked off.

"Be Grim and Bear It"

The pilot we had taken on soon learned of our troubles. He hadn't been on board 15 minutes when we had had two emergency stops, caused, in this instance, by the feed pump tripping out. As usual, the watch engineer had rung down "stop" on the telegraph. After the second stop, the pilot turned around and raised an eyebrow or two at such unorthodox procedure. So out of the kindness of his heart, the second mate (who seemed endowed with a good sense of humor) encouraged him by saying, "Don't let that bother you, it happens all the time, the engine room gives the signals on this ship." So we dropped the hook that night off Annapolis. The pilot was "durned" if he was going to take that kind of a cripple up through the crowded and narrow bay channel and through the harbor. In the interim, the second assistant checked and reset the constant speed governor on the feed pump turbine.

We should have had a nice peaceful night at anchor but this was not our lot. One of the firemen went through the routine procedure of changing the oil burners. Ordinarily, this shouldn't be the cause for any concern but in this case, when he put the clean burners in, he neglected to light them. Because of the lack of steam gages in operating condition at the main control board, the third engineer had no warning of the trouble until he heard the auxiliary turbines change sound. An immediate investigation disclosed that the boiler pressure had dropped from the normal 550 psi to 250. The fireman and water tender were contentedly resting their weary bones on boxes in front of the boilers, dreaming off into space, and totally unimpressed by the obvious lack of fire in the boilers. The third assistant was fit to be tied, and was still so mad a half hour later that he could hardly speak straight.

And as if this weren't enough, another fireman pulled about the same stunt on him on his next watch. This time the fireman failed to provide another burner or provide larger burner tips so that the burners would carry the load. When discovered, the pressure was down to 300 psi, but this fireman was as unaware of the trouble as the other one had been—despite the fact that the combustion control board was going wild trying to keep up with the demand, and the turbine forced draft fans were wide open and practically screaming. We almost had to put the third assistant in a straitjacket after this one—and he was usually a calm, peace-loving man, too. We all sympathized with him. But there wasn't much anyone could do about it except to "be grim and bear it."

Repairmen Come Aboard

We finally reached the unloading dock—under our own power. But we weren't taking any chances on a breakdown on this part of the trip. The author was stationed at the feed pump, the third assistant was in the boiler room, and the first assistant was at the controls. The second assistant had just gone off watch.

All went well at the unloading dock until a gang of repairmen came on board. This gay, whooping, and hollering bunch almost drove us crazy until we threatened to reshape their heads with a crowbar if they let another yipe out of them. To us, a whoop or a holler meant trouble on the run. Besides, our nerves were on edge and we were in no mood for fun. Part of the gang started to fix the main steam gage at the main control panel, while we were using the main turbo generator for power for pumping the cargo.

The author was on watch and got caught on an item that was to be remembered later on, for good cause. One of the men couldn't get at the steam gage as conveniently as he would have liked to, so he opened the access door to the 3600 volt, 1200 ampere control panel. This door was provided with an interlock trip and cannot ordinarily be opened when the power is on. But this workman was undaunted by such trifles and, as nearly as we could gather, used a bent wire to catch the inside latch and thus open it. This immediately tripped out the generator excitation, de-energized the main control board, and cleaned the pumping panel. So there I was. It was suspected that the workmen had something to do with the trouble, but even though aware of the trip on the door, I didn't tumble to what had happened. It was observed, of course, that the excitation current and the rest of the control and pumping panels went dead—suddenly. The chief was called, and the rest of the boys immediately showed up to see what was cooking. No one seemed to catch on as to the cause of the trouble except the second engineer, who got a bit disgusted after about 15 minutes at this performance and at the lack of perception of his fellow engineers and went back of the switchboard and slammed the door shut.

The pumping was completed without further difficulty and we moved out into the harbor to anchor and await further repairs. It was interesting to note that several days later, while the main board was energized and being tested, the same crew of workmen pulled the same foolish trick of opening the safety door. Being steamfitters, they probably had never had an opportunity to witness the spine-straightening jolt of 1200 amperes backed up by 3600 volts. (A lot of us have no interest in finding out.)

Things Were Still Happening

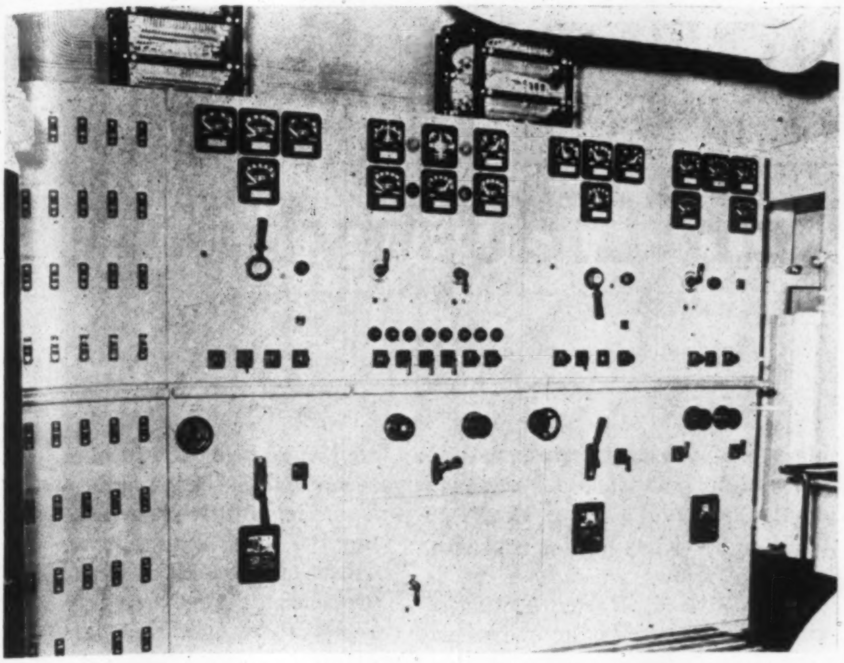
Anyhow, with the trip completed, the engine crew left the ship like the proverbial rats. They knew what they were doing, too, because things were still happening.

The first evening at anchor, all was quiet until something blew out on the 150 psi steam service below with a loud report. This was serious because there was no root valve for this line, and the 150 psi service fed the reducing valves for the 70 and 10 psi services which fed all of the essential services, including fuel oil and feed heating. The first assistant was called just in case of serious difficulties, and in the meantime the matter was checked at close range. The area was well fogged up with steam by this time but close investigation showed that the gasket on a trap draining a steam and water separator had blown out. The trap was secured and the "emergency" concluded. Ordinarily such a happening wouldn't have been cause for too much alarm, but for the jittery state we were in, every incident loomed large until proved different.

Heating the Oil

Several other items, concluding this episode, might be of interest. As it was late December, the weather was rather cold outside, and the lube oil gravity tanks were cooler than they should have been with the main unit on the turning gear and the lube oil system still in operation. So an attempt was made to heat the oil with the steam coils provided in the gravity tanks for that purpose.

Ordinarily all oil heating on the ship was done with steam from a contaminated evaporator, but like much other equipment on the ship, this evaporator wasn't working either. So the steam had to be provided from the 70 psi reducing valve through a crossover. This would have worked fine except for the fact that the crossover line to feed the lube oil heating coils led *down* to the contaminated evaporator, and the lube oil heating line went up about 35 ft from the cutout valve



One of the men couldn't get at the steam gage as conveniently as he would have liked to so he opened the access door to the 3600 volt, 1200 ampere control panel, which ordinarily can't be opened when the power is on. Apparently he used a bent wire to catch the inside latch and thus open it. This tripped out the generator excitation, de-energized the main control panel, cleaned the pumping panel. (Photo shows a similar switchboard.)

at the evaporator. As a result a considerable part of the line was pocketed and no way was provided to drain it, so the line was filled with a considerable amount of water.

When the contaminated evaporator was in service, condensation could have drained back into the contaminated evaporator. The line still could have been drained to this evaporator except that its cutout valve was frozen shut—really frozen. We tried a valve wrench on it, but it gave not the slightest indication of budging without possible damage to the valve. We still attempted to get steam up to the oil tank coils by bypassing the steam traps and trying to ease the water out. But the elevation of the coils above the water was too great, and after several resounding and definitely serious water hammers we gave it up.

Actuating Line for Combustion Control Causes Trouble

As soon as we had unloaded our cargo, left the dock and anchored, we cut out the port boiler, which was in the worst shape in all respects, including salinity—being about 8 grains per gal. This is high enough for this type of boiler. Anyhow, in cutting it out, it was necessary to cut out the combustion controls to the boiler and to secure the various actuating lines, as well as the steam and feed lines. The superheater, of course, was vented. But in the process of shutting the boiler down, we started having trouble with the starboard boiler. Its pressure was going up, but the combustion master control showed the pressure below normal. Consequently, it was opening up on the fuel and air controls. A frantic check was made as to the cause, and just as the boiler safety valve popped, the reason was discovered.

This ship had a steam actuating line to the combustion control system from *each* boiler (rather than from the main steam line, as is the usual case). Thus when the one boiler was secured, the stop valves for the boiler, both at the boiler and at the main, were closed. But the actuating line hadn't been closed. So the combustion control was averaging the two pressures and opening up on the starboard boiler in an attempt to regain normal pressure. Closing the port actuating line immediately corrected the trouble.

To vent the superheater of the port boiler, we cracked the superheater drain valve. At least that is what was intended. The packing for the valve was so bad that most of the steam came out through the stem, and this continued, even when the valve was shut off. After several hours of blowing, the valve and the adjoining pipe were white with chemical which had carried over from the boiler drum, a good indication of the degree to which the boiler water had been doctored.

Well, along came New Year's eve and the grand finale. Everything else, almost, had happened. So just to wind things up right for the year, we lost our vacuum on the plant. When it went, it went fast—in a matter of seconds. Don't ask *where* it went or what caused it. We never did find out, although we had our suspicions. We were short handed and having, personally, stood a night watch and then been on all day following, I was a bit groggy. So it was a weary fight we put on from about 5:00 p.m. to about 9:00 p.m. trying to lick the problem. We changed from the main condenser to the auxiliary condenser and back again several times. We "twisted" so many valves that I was turning them for a week afterward in my sleep. But we never did get the vacuum completely back for the time I was still on the ship to observe it. When last seen on New Year's day well along in the morning it was still only up to 25 in. in lieu of 28 or 29 in., as it should have been.

Sometimes I'm not really sure whether this trip was real or whether it *was* a nightmare.

ESTABLISHES GASEOUS FUELS FELLOWSHIP

The Bryant Heater Co. has established a graduate fellowship in gaseous fuels at Case School of Applied Science, Dean Elmer Hutchisson, director of research, announced recently. The fellowship, which is open to graduates in mechanical engineering, carries a stipend of $1850, of which $500 is in the form of tuition. The holder of the fellowship will be employed by Bryant during the summer preceding the term in which he begins his studies.

Applications for the fellowship should be filed by April 1, 1947, with the Dean of the Graduate Division, Case School of Applied Science, Cleveland 6, Ohio. Further information as to graduate requirements and the necessary application forms may be obtained from the dean.

CONSTRUCTION . . . .

It Is an Industry!

ATTACKS ON THE building industry of the kind so common a year ago, have ceased. Remember what Life said, "Never was there an industry which so little deserved the coming boom . . ."? The Wyatt housing program has proved more conversational than real. Wilson Wyatt is out. Priorities on building materials have been discontinued, as well as the fiction of the limitation of $10,000 cost on a veteran's home.

The Wall Street Journal said December 16, 1946, "Building industry sees '47 construction at new high as controls are eased. The estimate of $15 billion in new construction will probably be exceeded. This compares with a possible $10 billion for '46, and $4.8 billion for '45. This would be record high for construction, the previous highs being about $13.4 billion in 1942 wartime construction and about $11.5 billion in the building boom year 1926."

Did the attacks of a year ago on the construction industry help solve the problem? Probably not. As I recall, the central theme of the Time, Life, Fortune dream was the wonderful panacea of something new in prefabrications. Prefabrication has been responsible for a very small share of what building has been done and we can expect little more from it this year. Permanent homes simply do not lend themselves to prefabrication.

Veterans Want Rental Housing

As a matter of fact, it's been found—in fact, it never should have been lost sight of—that the veteran doesn't want to buy a cheap, single house. He wants a place in which to live that is reasonable in *rent* and that will permit him to devote his energies to finding and licking a good job without the responsibilities and financial risk of home ownership.

Later on—when his job is secure, when he knows what town he is going to live in, in what section of a big city his work is in, and where his friends are settling—he may want to buy or build and will know what he is going to use for money. If he is settled in his job, the fluctuations of the real estate market are unimportant. Every one of us now advises our own returned service men to try to rent, not to buy. So why spend taxpayers' money trying to subsidize a new phase of the building industry to cater to the assumed demands of the veteran, which demands exist chiefly in the politician's mind?

The problem is now being faced more honestly. The old building industry is ready, willing, and able to go ahead with housing and commercial construction in tremendous volume. If we can get rid of the few remaining controls and then keep artificial insemination out of the business, we can look forward to many years of high volume building of all kinds.

What the Building Industry Is

We do not wish to point with pride nor to view with alarm but to bring out a few characteristics of the construction industry that are of general interest and may help to a better understanding. This industry is not perfect nor is it lily white. It embraces its share of incompetents and crooks. What industry is free of them? (Even our beloved sporting industry smells once in a while.)

The question is: Do the people in the industry know its evils and shortcomings, and are they doing anything about it? In this sense it seems to me the building industry is making a little progress, and during the next few years can make great improvements. What are the problems? What has been done? What can be done?

The building industry is that combination of finance, art, science, labor, management, utilities, and government which takes raw materials and vacant land and produces houses and apartments to live in, industrial and commercial buildings to work in and to supply goods and services, schools for education, hospitals for the sick, and prisons for the crooked. Who can say which is the most important construction to proceed first and which to defer? Who is to say that costs in the future will be lower or higher than now? If government building is to be used as a balance wheel when private construction falls off, government should now defer its building.

The one valid criticism of the construction industry is that it costs too much to build anything. That's true of the automobile, the electric appliance industry . . . . . in fact, everything costs too much. At least the automobile business is no longer being held up as a shining example for the building business. High as they are, building costs are not as far out of line with prewar costs as are automobile costs (and you can't get automobiles, either).

What Makes Construction Costs High?

Without trying to oversimplify a very complex problem it seems to me that excessive construction costs are due to several very different causes and require widely different remedies but all add up when you talk about the building dollar. For

Lester T. Avery Points Out That Attacks of a Year Ago on the Building Business Have Stopped, That It's Making Progress; Sees Great Improvements in Coming Years

ALMOST A YEAR AGO Mr. Avery, president of the Avery Engineering Co., sprang to the defense of the much-maligned business of building in two articles published in our April and May issues. The attacks on the industry so common a year ago have ceased, says Mr. Avery, and $20 to $22 billion of construction has been predicted for 1947. . . . In this review, Mr. Avery discusses the construction industry, what it is, why it is what it is, and some of the changes that are being made. He stresses that building costs are no higher than other costs ("everything costs too much"), lists reasons for high building costs.

quick appraisal we list a few. High cost of building is partly due to:

1) Delays in getting materials on the job as needed.

2) Delays due to weather conditions.

3) Changes on the job due to incorrect plans and specifications.

4) Changes on the job due to the owner "changing his mind" after seeing something in place.

5) Loss of time of mechanics due to poor management and supervision.

6) Low output of labor.

7) High financing cost because of delays and slow completion to the point of usability and sale.

8) Restrictive building codes.

9) Restrictive labor practices, both jurisdictional and as to use of labor saving devices.

10) Forced overtime.

11) Competitive bidding.

Because competitive bidding has long been the bible of the construction industry and is alleged to do something about reducing costs, it may shock you to see it included in the list of items making for high cost. Experience during the war demonstrated the economy of building fast, each contractor being paid for labor and material used, and a fee for his supervision. Any contractor must figure labor and material cost and no contractor has any particular buying ability in materials that enables him to pretend to a lower cost. The contractor pays scale wages for labor. His insurance is fixed. What does he have to compete with? Only his overhead, which is mostly the cost of supervision—and estimating. Contractors have always had to charge the cost of estimating the work they did *not* win to the jobs they did win, as an overhead item. By and large the overhead is a fairly uniform percentage, depending on the type and size of the job. Profit is a fraction of a per cent.

The only thing you can say for competitive bidding is that a contractor is supposed to supervise a fixed price job more closely than the open price job, which might be true in some cases. The old cost plus percentage work rightfully has no appeal as there is a premium on increased costs. The cost plus fixed fee is now being used practically to the exclusion of competitive bidding, and it is working out well for the owner and the reliable contractor. Even competitive bidding will not protect against the unreliable contractor. So costs are now being reduced and will further be reduced by the gradual elimination of the wastes of competitive bidding.

In multiple house building, still further economies are gained by the builder developing a rather complete horizontal organization to buy many materials and developing assembly and prefabrication shops at the job site, with a permanent organization of skilled mechanics in all trades. The builder is the owner and rents or sells to the occupant. The important gain here is the lower unit cost from steady month after month construction on similar houses, leading to mechanical efficiency.

Benton Lefton, a builder of this type, tells me that two plumbers will rough in a six room house complete in two days; two electricians will completely rough in wiring for the same house in one day; plastering gets down to less than $1.25 per sq yd, cheaper than most any other kind of wall finish. Manufacturers are offering these builders direct dealer franchises for the purchase of appliances. Once the supply of these materials starts to flow uninterruptedly we can expect further economies from this noncompetitive bidding method of construction, in my opinion.

The Business of Overtime

This business of blackmail overtime is a truly vicious thing. It started as a method of bribing labor surreptitiously, as the contractor who wanted to get the best mechanics offered Saturday work. Then it was used by other contractors instead of a wage increase under NLRB. In New York City the day's pay was set for seven hours, the eighth hour being overtime, hence double time—therefore, nine hours pay for eight hours work. In Cleveland and Akron you were told you had to work Saturday or the men would go to other jobs that did have some overtime.

Well, that racket is recognized for what it is and is on the way out. New York contractors and unions have recently agreed to a straight 40 hr week, no overtime allowed. Cleveland contractors have agreed to stop all Saturday and Sunday construction. Other cities will follow.

The worst problem will be to handle the industrial plant owner who insists—although he comes out fighting his own labor at the suggestion of unearned overtime—that cost is no object, he simply has to have the new facilities, and, says he, "Work the men Saturdays, Sundays and holidays, anything to get the men and keep 'em." Demoralizing, isn't it? Let's have the guts to tell him to get back onside and play the game square. A 40 hr week is the agreed work week; let's work it. If labor wants 48 hr, let's change the rule to straight time—no cheating! Or maybe the trades want to make a grand contribution to housing. They could agree that on housing—single or multiple—any and all trades would work 48 hr at regular rates. After all, $2.00 to $2.50 an hr isn't poor pay and it would have the same effect as adding 20 per cent skilled mechanics to the present short supply.

Restrictive Labor Practices

Excessive costs due to restrictive labor practices are being reduced in many areas by progressive labor unions and contractors. The present shortage of labor has made it unnecessary for the unions to guard so jealously all their prerogatives.

In New York City the electrical unions and contractors announced they would not disassemble devices which came in with electrical connections built in. Multiple housing has shown the advantage of power carpenter tools on the job and no restrictions now prevent their use. Any steamfitter or plumber is glad to use power operated machinery. If there still are restrictions on labor saving tools or methods they are indeed rare and are waiting on enlightened leadership for correction.

Jurisdictional restrictions have been eliminated in the piping trades by combining the plumbers, steamfitters, gas fitters, welders, and refrigeration erectors into one union. Other trades could well combine some of their activities. Leadership is needed to get rid of jurisdictional squabbles and waste work between the carpenters and sheet metal workers, between bricklayers and plasterers—in fact, there should be a completely new approach to this problem. Let the mechanic belong to his own trade, the one in which he is most skilled, but withal he is a bona fide member of the AFL construction industries united association. Then if he has the skill to do other trade work and it touches his own he should be permitted to do so. A fitter should be permitted to insulate his work, and paint it. The carpenter should work in sheet steel or wood or both. Any mechanic that can mix cement and handle a trowel should be permitted to work on anything in the trowel trades. To date very little has been done to simplify the trades and their jurisdictional problems except in the pipe trade. Other trades, please copy!

Restrictive Building Codes

Restrictive building codes are being disregarded or are being changed. Unfortunately this code business is wrapped up in fire protection and the recent disastrous fires (particularly in hotels) are tending toward even more strict codes and their enforcement.

In Cleveland the building code is being rewritten with an effort to make the restrictions functional rather than specific. For instance, a wall must be strong enough to carry a specified weight, or a roof must carry so many pounds per square foot, and must have certain fire resisting qualities, rather than specifying walls of any particular thickness or material, or specifying roofs with any particular supporting system or material.

If we could get the prima donnas out of the building departments who think they know the one and only way to build anything and open up this problem to a national point of view we could get along faster and would probably get reasonable fire safety and reasonable cost. Each city could set its own geographical limits as to number 1, 2, 3, or less, fire hazard, but all cities would follow the same code requirement for any class hazard. If New York City needs extra stringency for its skyscraper district, that should be so classified and any other city that had a similar hazard would follow that code. Why should fire hazards in the Chicago Loop be any different than in Wall Street?

Building codes are now being revised; in fact, are in a constant state of revision. Gradually the pet restrictions favoring some particular material or make work plan concocted by labor or contractors are being eliminated.

Labor's Output

Much has been said about slow output of labor, as if labor were deliberate in slowing down output. This may be true in manufacturing but it is not true in construction. There is so much work to do and so many reasons for hurrying that the building mechanic is by and large doing the best he can. The delays in getting the right material at the right time have run labor cost way up. Poor supervision and planning have been responsible for waste labor.

But worse than these is the large number of superannuated building trades workers. During the war construction was not classified as an essential industry, so the young men went to war. The slow labor complaint is therefore to be expected because of the large number of older men and the present large number of green young men. Sidewalk superintendents notwithstanding, it does take a few years of training and experience to make a building trade mechanic, so the new apprentices we are getting now are young but slow and will continue slow and expensive for the next few years. There is no shortcut, but the employer can hasten the efficiency of his new young workers if he will take the time to train and supervise. Most employers are too busy settling more pressing problems and they never before had to train any mechanics, so they not only aren't doing it, they hadn't realized they would have to do it, and equip to do it.

Errors or Changes in Plans

Some costs are unnecessarily increased because of errors in plans or specifications. Registered architects and engineers are supposed to know all the requirements of good, safe building. Sometimes, however, one of their employees makes a mistake that isn't caught until something special gets on the job that doesn't fit. Sometimes they are unaware of certain code requirements covering special classes of work such as public buildings. Sometimes a mechanical contract is let without being provided for in the architectural plans, requiring changes to permit pipes, ducts, lighting fixtures, etc.

Sometimes the owner changes his mind. When you start to cut lumber to size, pour concrete, and run pipes, you should be sure of the end result. Then there will be no "change orders," and you can build or remodel your dream home (or building) without wasting money.

Weather Always a Factor

The building industry in the northern states has always suffered from weather delays in the winter. Three years ago we dug a hole for the foundation of a Sunday School the first week in December. There it lay, collecting snow, water, caving in the sides, and in general being a hazard and nuisance until the first week in March. Three months in which no outside work could be done.

Very little has been done to change the weather outdoors, although man has done a pretty good job of it indoors. Some winters are milder than others. Some work can be done in freezing weather. A builder near me started two houses at Thanksgiving time 1946, had them under roof in two weeks, closed up the window and the door openings with heavy cloth, and is doing a fair job of getting these houses finished. Multiple housing projects have frequently included a covered and heated assembly building where certain work could be done in any kind of weather. But weather is to be considered in cost, especially when other delays extend a project into winter that should have been finished in the fall. Now that we can get materials it should again be possible to start buildings so they will be under roof and protected by December.

Delays due to any cause set up a vicious train of circumstances that seriously affect building costs. So far we have been spared any general building trade strike such as shut down the automotive, steel, railroad, and coal industries last year. Over a period of 20 years now the contractors and trades have learned to work together and the increased price of building labor went to labor, not to making up for lost time in strikes. There have been a few local strikes but nothing of much national significance.

Deserve the Coming Boom

As of January 1947, the increase in building cost for equivalent specifications is about 40 per cent in labor rates, 50 to 60 per cent in most materials, and 20 per cent in mechanical trades as compared with 1939. Overall, this is about a 50 per cent increase. Automobiles are up about 100 per cent, electrical appliances 50 per cent. The building dollar is a sound dollar and from now on should buy a gradually better building.

We need commercial as well as residential building. We need new industrial plants to make the equipment required for residences. We need electric generating plants to furnish light and service for the appliances in these new homes. We need telephone buildings to provide phone service. And moving picture theaters and bowling alleys and stores to serve new centers of population. And hospitals for the veteran and the nonveteran—even the poor old building trade worker who broke his back working 60 to 80 hr a week in the war days building the plant to make the materials to win the war.

As George A. Bryant, president of the Austin Co., has said, "If the government will but recognize that production facilities are equally important to the public welfare as housing, a substantial number of supplying firms should be catching up with industrial construction demands by midyear." Eight hundred thousand to 1,000,000 new living units in 1947, $15-$20 billion in total construction; better buildings at lower cost—these are promised by the construction industry, now that politicians and bureaucrats have abandoned the building business as being beyond salvation, or whatever it was they were going to give it.

Well, we're on our own now and somehow I feel that these estimates for 1947, coming from responsible representatives of our own industry, will be much closer fulfillment when the year is finished than were the prognostications and dreams voiced by the planners who had the columns a year ago. Let us pull ourselves together and deliver buildings—better, faster, and cheaper—and prove that we not only "deserve the coming boom" but that we are helping to create a very stable prosperity.

A Cleveland Press editorial of December 27, 1946, said, "United States commerce department thinks nearly $22 billion of construction will be done, of which two-fifths ($9 billion) will be housing. . . . The Associated General Contractors expects $20 billion next year. . . . Building seems to be a sort of barometer for general prosperity. In years when the construction industry is active, other industries usually are . . . and big building volume ought to mean lower prices, increasing the number of houses, apartments, factories, stores and repair and maintenance jobs that money will pay for."

Quick Picture of the Convention

IMPRESSIONS OF THE ASHVE'S ANNUAL MEETING

IT STARTED FAST and finished fast. If you couldn't get here, too bad. If you were here, very good.

Homer Addams, the ASHVE's charter member, and Mrs. Addams were on hand the first thing Monday morning to start everything on a high plane for the 53rd annual meeting. Homer went out to the new laboratory and was astounded—as were many others—with its size and facilities and general value. For $75,000 we have a plant that is worth two or three times that!

Dr. Willard was there, and Holt Gurney and Merrill Blankin and Sewell Downs, and a lot of other loyal ASHVE's. About 600 altogether joined in that Monday morning session and laboratory dedication.

Yes, we opened the 7th International Heating, Ventilating, and Air Conditioning Exposition Monday afternoon. Biggest ever in area used. Greatest attendance (30,561) for the week by 50 per cent. This industry is really growing up. "Take off the short pants, Bud, and stand up straight. You're a big man now." You should have seen the wonderful exhibits. I mean the wonderful arrangement of color and lights and motion. You didn't know engineered products could have sex appeal did you? Well, they had something, and maybe that was IT.

If the whole world doesn't go in for automatic heat, clean air, and complete air conditioning pretty doggone fast it's because too many of them didn't get to Cleveland the last week in January.

A Sellout

The Monday evening get-to-gether was a sellout. The Chagrin Falls players did a wonderful job—according to the people up front who could hear but with 800 or more in that ballroom a lot of us were a little out of range. But we did see and enjoy the other parts of the show, the band, the "Clevelandaires," and the puppets—especially those blackfaced boys that danced in unison so beautifully. OH yes, don't forget the puppet with the striptease act. She really had and did everything.

Tuesday's technical session on dehumidifying played to a good house. Good papers. But you should have been there Tuesday afternoon in that panel session on radiant heat or whatever you called it. Over 1000 men and they stuck! After the first half hour the engineers got rid of their inhibitions and inferiority complexes and took their hair down. Or someone else's. I doubt if we settled anything very important but it was fun. If you weren't there you probably were talked about.

Who else went to bed early Tuesday night and caught up on shuteye?

New Slants on Health

The Wednesday morning technical session was crowded. Wonderful papers by the medicos on some new slants on health and industrial air problems. Most important and something the society has to get into and fast. We don't know nothing about air for health. How long does man have to work in bad air like he used to work in bad light before we find and can prove that "good air is good business." If you missed this one you'd better get the papers and read 'em carefully. They're important but we've got more important stuff on the stove. Watch for the next dish.

Calm and peace Wednesday afternoon—couldn't set up the refreshment stand outside the banquet hall because we had to use the space for tables. Nine hundred and ten engineers or a reasonable facsimile thereof paid six bucks per copy for a banquet seat, and didn't know nor care who the speaker was. As a matter of fact the speaker was late on account of the planes not running from Detroit where he spoke at noon to a women's club but he took a bus to Toledo and grabbed a train which got in Cleveland at 9:10 p.m. Nobody cared much and wouldn't have known except we slowed down the dessert service and he did arrive in the middle of it in his working clothes. Very good talk, didn't scare us much, and I think we liked Dr. Kirtley Mather's easy friendly style as much as his message. Swell food, fine people, excellent service, good speech, good orchestra, genteel dancing with old acquaintances. What more do you want in a banquet? 'Twas wonderful.

And then—wonder of wonders—the Thursday morning technical session was full, over 300 (maybe different people some of them; but all the old standbys). Registration to noon Thursday was 2215, of which 1247 were MEMBERS. We have 25 living past presidents and 15 came to this convention. Can other engineering societies bring their people back like this? The new officers got inducted and between Past President Bill Jones and P. P. Merrill Blankin they put on quite a show. Looked kind of extemporaneous to me but much better than past performances. We really should work out a good ritual on that one. It could be very impressive.

Topflight Speaker

Thursday noon Baldwin Woods (new president to you if you weren't there and don't read your mail) addressed the Cleveland Rotary Club on gadgets. Swell talk—I think more inspirational and interesting than a lot of professionals I've heard (including some recent exposures). If any of you people want a topflight speaker who can disclose science to a layman in a simple painless fashion, our worthy new president is your man. All the ASHVE officers and 10 member Rotarians at the head table. Forty-nine visiting Rotarians in the audience. This industry really is growing up. That's as many Rotarians as we have ever had with any convention or exposition that has come to Cleveland.

Thursday afternoon was the joint session with the National Warm Air Heating and Air Conditioning Association in the Public Hall ballroom. Two good speakers and an interested audience. Friday the exposition closed and some people breathed a sigh of relief. Well it *was* a good exposition, it was a *good* convention, and a lot of *fine* people were here. Sorry if you couldn't come.—LES AVERY.

Insulated Overhead Pipe Line Solves a Plant Steam Problem

Increased Steam Needs Met by Existing Generating Capacity 3000 Feet Distant

HOW A LONG overhead pipe line that supplies increased steam needs from existing excess steam generating capacity a half a mile away was insulated is described

TWO YEARS AGO the Jones & Laughlin Steel Corp. was faced with the problem of providing large quantities of steam for the open hearth and rolling mill division of its Otis plant in Cleveland. Procurement of a new steam generating plant would have required too much time, due to the then tight supply and delivery situation in such industrial units, and the steam was needed right away.

More than half a mile from the point of need, J & L had excess capacity in the form of a complete steam power division supplying other plants and operations. But between the Otis plant and the steam boilers, the intervening 3000 ft included more than a dozen rail lines, roadways, service lines and the like, precluding efficient installation of an underground pipe line.

The problem could be solved by a line suspended from the appropriate spans of one of Cleveland's major bridges across the Cuyahoga River, and thus all intervening obstructions bypassed—but all fully-exposed steam lines with which J & L had had former experience were both inefficient from a heat loss standpoint and a nuisance to maintain in view of the friability of the insulation. Further, it was imperative, if the line were to be suspended so high, to use insulation which could largely be applied to line lengths on the ground before welding in position, and which need not be regularly inspected or patched.

The solution lay in the application of blanket type mineral wool, with sufficient fibrous structure to resist vibration and fracture while retaining high insulating characteristics and light weight.

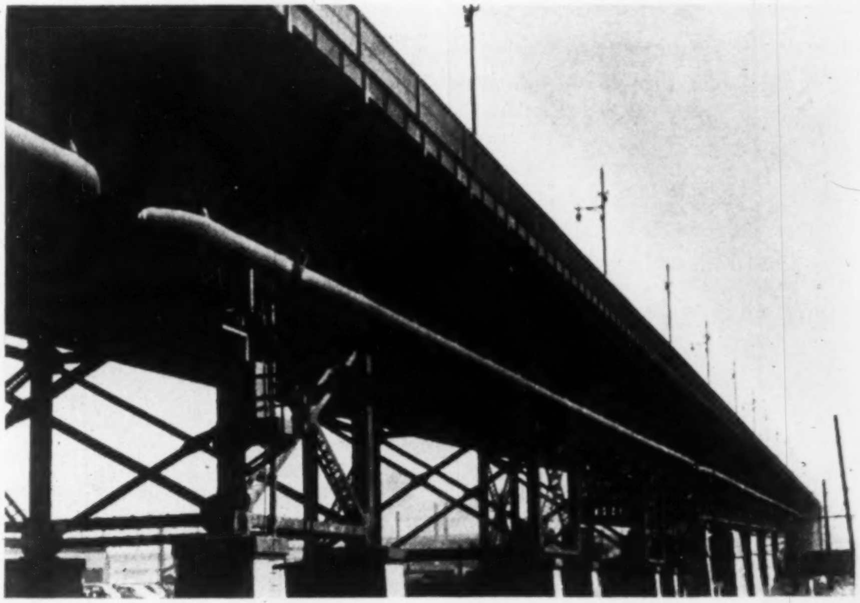
Specifications called for 3350 ft of 14 in. pipe of ⅜ in. wall thickness, all joints to be welded. The line carries steam at 235 psi at the boiler end, which pressure drops to 215 psi at delivery.

Blanket Mineral Wool

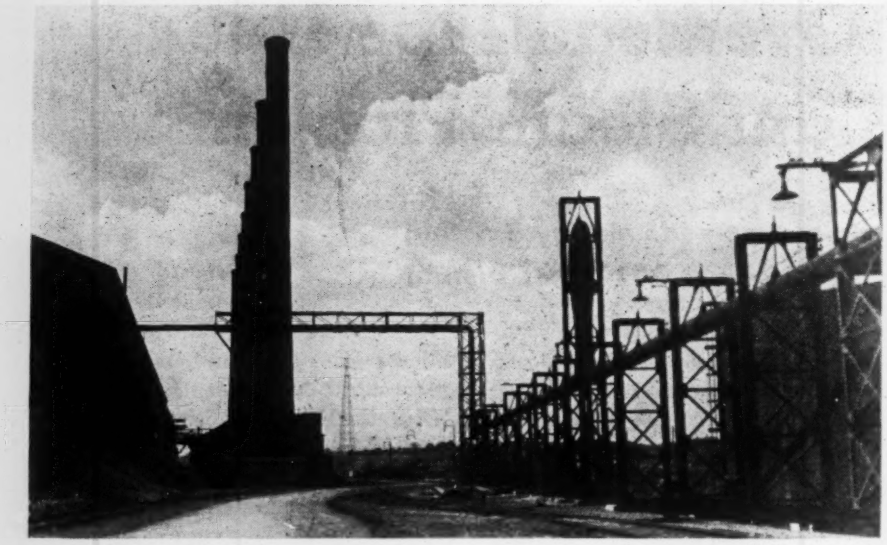
Insulation was accomplished with 2½ in. of blanket mineral wool, wire faced and metal lath backed. All joints of the lath were securely fastened with clinched pig rings. Vapor and weather sealing was done with two layers of 75 lb asbestos felt, asphalt impregnated. The first layer was cemented with 3 in. lapped seams and strapped on 12 in. centers with patented strip steel fasteners. The outer layer was similarly lapped, hot mopped with asphalt and strapped on 12 in. centers, the steel straps being spaced to allow 6 in. separation between inner and outer supports. In addition, after the line had been suspended and all welding gaps covered, the entire length was wire wound, then brush coated with a heavy layer of roof type, cold resistant paint.

Steam was run through before the supports and weld zones in the bridge section were covered. The initial drop, even in the incompletely protected line, was substantially less than anticipated, being in the range of only 20 psi pressure drop, coupled with no more than 50-70 F of superheat temperature loss.

When insulation was completed, the temperature differential between the initial and delivered steam was only 10-15 F of superheat, in steam at 550 F—of which 100 F was superheat which had to be removed before use because of the unexpected high efficiency of the line. This was so superior to the anticipated drop of 70-90 F that the engineering department's attention was focussed on the economies possible in additional distribution of steam from their large central



During maintenance work on this bridge, which supports part of the 14 in. steam line, objects were allowed to fall on the piping in numerous places but no serious damage was done to the pipe or to the insulation



A dozen rail lines, roadways, service lines and the like precluded efficient installation of an underground line

boiler plant, and the additional boiler capacity originally planned was never purchased.

Proof of the durable qualities of the insulation was accidentally obtained in the course of certain maintenance construction work on the bridge some months after the line went into service. The bridge contractors were warned to be careful of the steam power line and not to drop bricks, tools, etc., on it during their work. However, such objects inevitably were allowed to fall on the line in numerous places. Fearing serious harm had resulted to the lines, Jones & Laughlin required the contractor to correct the damage.

Some months elapsed before the mineral wool applicator could attend to the repairs. In that time, no perceptible variation in temperature or pressure of the steam was noted. It was feared that sections of the line would have to be replaced, forcing a shutdown in service. However, when detailed study was made, it was ascertained that the shock absorbing characteristics of the lath backed, fibrous mineral wool had prevented any damage to the steam line itself. The total extent of harm was a number of breaks through the asphalt felt cover. These were corrected without disturbing service.

Provides Design Data for Overfire Air Jets

The value of overfire air in smoke abatement is being given increasing recognition by manufacturers of steam generating equipment, in the opinion of W. S. Major, development engineer, Bituminous Coal Research, Inc., whose paper, Have You Considered Overfire Jets for Smoke Abatement, has been reprinted from the August 1946 issue of Finish.

As Mr. Major points out, new steam generating units are generally installed with carefully designed furnaces, often with overfire air, to meet the fuel and load conditions of a specific application. In addition, automatic combustion control and cinder or fly ash collectors are often used.

From the standpoint of smoke abatement however, there are many plants having older and less efficient equipment and though both the owner and the plant operator desire to cooperate on abatement, the problem of smoke control is not easy. This paper is directed primarily to owners and operators of these older plants, for the author recognizes that any device which is to gain wide acceptance must be inexpensive, easy to install, and have a moderate operating cost. In his opinion, the use of overfire auxiliary air is one of the best and most practical tools available.

Only a thorough investigation of each installation, he says, will provide the necessary information for selecting the proper type and design of jets to be used. While operating cost factors usually favor the use of moderate or high pressure blowers, there are cases where steam-air jets are justified—such as in instances where blowers are not available, the initial cost is prohibitive, or where only turbulence over the fuel bed is needed and additional air would be detrimental to the furnace operation.

In 1942, Bituminous Coal Research started an investigation which was conducted at Battelle Memorial Institute under the supervision of R. A. Sherman, supervisor, fuels division. R. B. Engdahl, research engineer at Battelle, made extensive studies and tests on such factors as air entrainment with different tube diameters and lengths, steam consumption of various sizes and types of nozzles, flow characteristics, etc., and he has recently prepared a report of the investigation, Technical Report No. 7, Application of Overfire Air Jets, which is published by BCR. The sketches, charts, and design data contained in both Mr. Major's paper and the BCR report were prepared by Battelle.

The various charts and tables provide jet design data and sketches of recommended proportions for nozzles, silencers, and installation details will be helpful to the reader. In using the tables and charts such factors as the heating value of the coal, burning rate per square foot of grate per hour, smoke density, and desired jet penetration must first be determined.

It is pointed out that jet locations as recommended in this paper are being used successfully on many jobs but they should not necessarily be accepted as a firm pattern, for there are too many variable factors existing between different furnaces which warrant a thorough and individual study. The author also recommends that suitable means be provided for observing stack emission in order that the attendant may know when to operate the jets, which are not considered a "cure all" but rather a very helpful tool.

Reprint copies of both Mr. Major's paper and the BCR report may be obtained from Bituminous Coal Research, Inc., 912 Oliver Bldg., Pittsburgh 22, Pa.

Big University Enrollments Stress Advantages of Air Conditioning

Classroom Facilities Employed to Capacity, Summer Attendance Increased, Teachers Easier to Engage, Says Omaha University

FACED WITH FAT enrollments and thin building prospects, school authorities are turning to air conditioning as one way to ease the burden of crowded classrooms and overtaxed facilities, says the Refrigeration Equipment Manufacturers Association. The University of Omaha gained the distinction, before the war [HPAC, September 1938, page 588] of becoming the world's first completely air conditioned university at an added cost of only 3c per cu ft to the original cost of the buildings, the REMA reports.

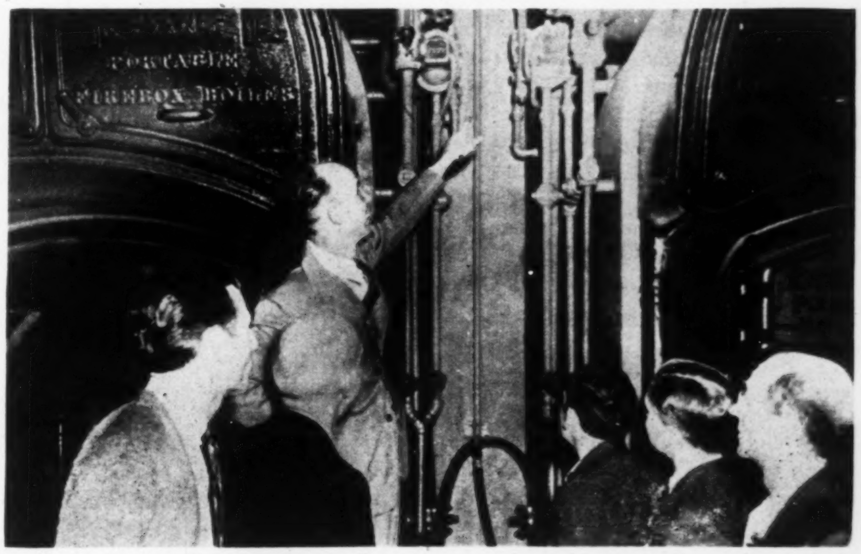
Overshadowing that distinction is what air conditioning has accomplished for the university since the war as enrollment has doubled and the year 'round school program has expanded in both size and scope. Combining winter heating and summer cooling throughout 1,750,000 cu ft in 200 classrooms, here are some of the results as reported to the association:

1) Despite twice as many students, classroom facilities are employed to capacity with the air in each of the school's 200 rooms regulated according to the percentage of occupancy.

2) Kitchens and laboratories are freed from objectionable air and therefore may be used longer and more frequently.

3) Summer school enrollments have increased because of the com-

An evening class in stationary engineering inspects some of the heating and air conditioning equipment at the University



WE'RE NOT TRYING to prove that air conditioning is a cure-all for the many problems besetting schools and universities in these postwar days of heavy enrollments and equally heavy teaching and administrative schedules but the experience of the University of Omaha reported here certainly indicates that controlled temperatures and humidities the year around help a lot

fort of the classrooms—the university's summer school has students from 40 other institutions.

4) Teachers are easy to engage during the summer—usually only one call is necessary.

The university's air conditioning system provides controlled temperatures 12 months in every year—an advantage that is being viewed by educators in terms of either lengthening the school year or otherwise employing school facilities continuously and without the interruption of vacation periods. In addition to maintaining 72 F throughout the winter and 72 to 79 F temperatures in the summer (depending on outside weather), the system washes and filters the air and controls humidity. These features are adaptable to the year 'round weather in Omaha, but school officials call attention to the value of the cooling features in southern schools where cooling the air alone would provide unusual benefits.

Reports from the Omaha school and other air conditioned educational institutions also point out that comfortable temperatures are conducive to raising scholastic standards and attendance records, and eliminate the loss of efficiency caused by excessive heat and humidity on the part of instructors and students alike.

Complete air conditioning at the University of Omaha was voted by the school's regents following consideration of an architect's plan for incorporating cooling equipment to operate in conjunction with already-installed heating facilities of the structure which consists of a center building four stories high and two wings of three stories each—actually, three buildings in one.

Two Wells Supply Water

Cooling equipment consists of two wells for supplying water, of which about 135,000 gal is used on an average summer day, mechanical refrigeration, and two storage reservoirs. Water pumped from the wells to a 100,000 gal reservoir travels to the refrigeration equipment, then to the cooling coils and condensers, and finally to a second reservoir, from which it is circulated for cooling. Following this use, the water is used for lawn sprinkling or diverted to sewers.

Other features of the system include 4 in. of insulation on the third and fourth floor ceilings, an air space of 1 in. between the 16 in. brick walls and the inside plaster, double glass and weatherstripping on all the 460 windows, and separate exhaust systems to dispose of used air from kitchens, laboratories, and other rooms.

DEVELOPS UNIT FOR TESTING FUEL OILS

The need for a standard means of determining the burning qualities of fuel oils has resulted in the construction of the first combustion comparator, to be known as the combustion reference test unit, the Oil-Heat Institute of America, 30 Rockefeller Plaza, New York 20, N. Y., has announced.

In times past it has been possible to determine the burning qualities of fuel oils by analyses of their chemical and physical properties but present day oils having almost identical properties by analysis may have quite different burning qualities, says the institute. Nowadays to tell how an oil will burn it must be burned, and heretofore this has been troublesome because there have been no standard burning tests or burning apparatus. There was need for a standard apparatus in which to burn the oil to be tested, prescribed conditions under which to conduct the burning tests, and a scale to measure how well or how poorly the oil burned. It is this need that the combustion test unit is designed to fill.

First expression of the need for a standard of fuel oil burning quality was made several years ago by Dr. Leslie C. Beard, Jr., of Socony-Vacuum Oil Co. He said he thought great good would be accomplished if burner manufacturers could design and build a standard burner for testing the suitability of oils for burning in various types of burners. The burner manufacturers picked up this suggestion and turned it over to the engineering committee of the institute, where a subcommittee was appointed to design and build such a unit.

The subcommittee produced the combustion reference test unit, and they have found in their preliminary tests that they have created not only a means for testing the burning quality of fuel oils, but a means also for making comparative tests of the performance characteristics of various oil burner component parts. Such comparisons they found could readily be accomplished by running parallel tests of known and unknown parts using identical oils of known specifications.

TRAVELING IN COMFORT

Air conditioning equipment made by the Carrier Corp. will protect the British royal family from Africa's torrid heat during their two-month tour of the Union of South Africa. A veritable "palace on wheels," the eight royal coaches are equipped with radio, telephones, and private baths.

The king's coach has a study, a stateroom and adjoining bath, a workroom for the king's valet, a bedroom for an equerry, and one for the king's physician. In the queen's coach is a lounge paneled in figured walnut, two easy chairs, two tub armchairs and a settee in walnut and sycamore in blue and gold brocade. The lounge has a silver and gold background and will serve as the royal living room.

The queen's stateroom is paneled with quilted maple and walnut. It has a wardrobe with sliding tray drawers and long mirror, and a dressing table in sycamore and walnut.

Also for the king's comfort, the senate chamber of the parliament building in Cape Town has been air conditioned.

SAM LEWIS' PAGE

IN THIS regular feature, informal comment on heating, piping, and air conditioning matters is given by Samuel R. Lewis, consulting mechanical engineer and a member of HP&AC's board of consulting and contributing editors

"I Learn Most from Trouble Jobs"

I THINK THAT I learn most from diagnosing trouble jobs and in prescribing ways to beat them. Of course, I have known all the time that you cannot get any more water into a full bucket without an overflow and that you cannot do much of a job of ventilating and cooling a room without at least an escape opening for spent air. I really do believe that you cannot do a successful job of air conditioning without an exhaust fan.

Here is a case of an amphitheater having a bowl floor. There is but the single room, with its apparatus devoted to that room only. An adequate refrigerating plant was installed. There is a supply fan having on its suction side an evaporator and a steam convector. There are face and bypass dampers at the heating-cooling convectors.

In winter, if the delivered air is too warm, arrangements are such that after the bypass damper opens and the face dampers in front of the convector close, a steam supply valve at the convector will close. In summer, if the delivered air is too cold, the face damper at the evaporator will close and the bypass damper will open. If the air is still too cold, the electric motor of the refrigerating unit will be stopped.

To install the thermostat that controls the room temperature in the exhaust duct from a room, so that the thermostat experiences a presumably true sample of the room air, heatwise, is an old practice. In this case there is a thermostat in the return air duct from the amphitheater but this is not an exhaust duct, since unfortunately there is no definite exhaust fan.

The return air duct—owing to restricted areas—stands on its side; that is, a narrow room adjacent to the conditioned room is used as a return air duct for the air from the amphitheater to flow back to the supply system. There are openings at floor level through the partition that separates the conditioned room from the return air space.

The entering conditioned air is forced into the amphitheater through diffusing grilles in a transverse duct close to the ceiling and at about the center of the room. The spent air escapes at the floor of the lower level or pit of the amphitheater. Having entered the adjacent narrow room or "return-air-duct-on-edge," the spent air rises to the top of the duct and goes to the intake of the air supply apparatus, where dampers are provided to mix some recirculated air with some outside air.

The design called for one-third new outside air and two-thirds recirculated air. No one disclosed what the designer expected to do with the one-third new air for which no pressure relief outlet or exhaust fan was provided.

There are four large direct steam radiators in the room. Each had automatic control by a separate wall mounted thermostat, one thermostat per radiator, but all in the same room.

They sent for me because of continued complaint of drafts by the 250 occupants.

I found these drafts evident below the nine air inlets from the centrally located, overhead air supply duct. I found them also in the zone within 10 ft or so of the spent air outlets from the room, where the air moved rapidly along the floor.

An outstanding curiosity was the fact that the narrow return air duct (the one "standing on its edge") had six large single glass windows and six large steam radiators and that these were controlled by a thermostat mounted on the wall of the duct-room.

The thermostat that was expected to control the amphitheater temperature was in this return air duct. A north wind carried away a

YOU CAN'T do a successful job of air conditioning without an exhaust fan, for what you would take out you must put in, says Mr. Lewis in discussing how an unsatisfactory installation (the occupants complained of drafts) for an amphitheater was corrected. Another difficulty was that under certain conditions the thermostats bucked each other. He explains the situation and how the troubles were overcome.

lot of heat through the windows in the return air duct. The thermostat on the wall then dutifully caused the six radiators in the return air ductroom to receive steam and to transmit heat.

Thermostats Buck Each Other

The duct thermostat charged with controlling the temperature in the amphitheater then became warm and dutifully did things to the bypass damper and steam valve at the convector in the air supply unit so that cooler air was sent into the amphitheater. This cooler air flowed down around the bedeviled humans in the pit on its way to the return air duct-room, further asking the wall thermostat in that room to increase the temperature in that room and ultimately causing still cooler air to enter the amphitheater.

The four thermostats already in the amphitheater—itching because they were too cold—tried to improve matters by heating their radiators but they could not scratch the seat of the trouble because they had no drag with the all-potent thermostat in the return air duct!

Here's How Job Was Corrected

To anyone who follows this tale, my prescription must be obvious, but I'll cite it.

The first step was to insulate the return air duct against heat loss through the cold windows and wall and to abolish the radiators and thermostat in this duct-room. The second was to move the duct thermostat to the outlet of the supply fan where it acts as a cool temperature limit in winter or in summer, to prevent passage of air so cool as to cause drafts.

The third move was to install a thermostat in the amphitheater acting as a pilot to the relocated duct thermostat and in addition controlling the steam supply valves on the four radiators in the amphitheater, so that all the controllable sources of heat are definitely under one responsibility.

Moral of the Story

The morals are that if you would take out, you must put in; that if you itch, you cannot get comfort unless you can scratch the itch; and that divided responsibilities are bad.

ARTHUR McCUTCHAN ASSUMES NEW DUTIES

Arthur McCutchan assumed new duties as senior research engineer of the Tube Turns product engineering and research department on February 1. Mr. McCutchan will be associated with A. R. C. Markl, chief research engineer, M. S. Noyes, research engineer, and H. H. George, research engineer.

The product engineering and research department, under the direction of J. D. Mattimore, chief engineer, is engaged in original research work having as its objective the improvement in design of welding fittings and their better application in piping systems, and in his new connection, Mr. McCutchan will have increased opportunity to enlarge his already noteworthy service to the users of piping products.

Formerly engineer, engineering division, the Detroit Edison Co., Mr. McCutchan has devoted most of his activity during his 20 years service with that company to the design of power plant piping. He has contributed numerous articles to HPAC on piping flexibility, flange design, and application of welding to high pressure, high temperature piping. His more recent contributions to the ASME have concerned graphitization of piping.

ENCOURAGE INDIVIDUALISM, ENGINEERS ADVISED

A "largely unexplored field" of engineering lies in the hearts of the men who work with you, Dr. Eugene McAuliffe, chairman of the board of trustees of the Union Pacific Coal Co., said in his address at the academic convocation commemorating the 75th anniversary of the Missouri School of Mines and Metallurgy. "The heart of labor has gone neglected for generations," he continued. "Its reward was, in the past, a meager existence; it is much better today with a more liberal payroll, together with workmen's compensation, unemployment insurance, and social security.

"The response received by the employer, unfortunately, is too often a grudging one. Where co-operative effort should exist there is too much dissension, with a resultant lack of production. The average workman's education is limited; he is too frequently compelled to leave school at an early age, to barter his labor for a living. His days are frequently monotonous, the task a repetitive one, and he never has learned to make work a game.

"To encourage individualism will be your duty; the measure of your success will depend on your ability to plumb man's secret desires. There is indeed a fourth dimension, it bounds the human soul. It is in the ability to win, drill, and train men that your greatest opportunity lies," Dr. McAuliffe concluded.

RUSHES QUONSET-TYPE FACTORY BUILDINGS

Faced with a two year delay in the construction of sorely needed additional plant capacity, York-Shipley, Inc., York, Pa., is rushing to completion two huge quonset-type manufacturing plants. These buildings have a combined working area of 60,000 sq ft and will provide immediate space for increased operations until a permanent factory can be built.

Lending themselves to speedy construction, the buildings have a triple dome centrally supported by vertical steel members. The exterior consists of corrugated iron sheets on a steel arch framework insulated with a 2 in. layer of rock wool and one layer of fiber board. The floors are concrete.

Quonset style plant to manufacture heating units for veteran housing

QUESTION of the MONTH ?

WHY FLOW THROUGH BURNER NOZZLE VARIES

ANSWERING the Question of the Month in the December issue on the subject of oil burner nozzle performance, the quantity of oil delivered through a nozzle on an oil burner during the operating cycle will vary with the temperature of the nozzle. This is true because a change occurs in the viscosity of the oil as it passes through the nozzle. For example, the starting temperature may be 70 F. After the burner has operated for, say, 30 min the temperature of the nozzle may be in the neighborhood of 200 F. For low flow rates of oil through the nozzle, the oil will assume the temperature of the nozzle through which it flows and, therefore, the temperature of the oil will be around 200 F. If the viscosity of the oil at 70 F is 42 sec, the viscosity at 200 F will be considerably less than that, or in the neighborhood of 30 sec. This change in the oil viscosity will cause the flow rate through the nozzle to be reduced by about 15 per cent in some cases.

The reasons for the reduction in the rate of flow with a reduction in viscosity are obvious.

The second question has to do with an even larger decrease or variation in the rate of flow when the same burner and nozzle are installed in a smaller combustion chamber. The reasons for that condition are obvious also to anyone who has taken temperature measurements on the combustion chamber walls and the nozzle under those conditions. For example, in a combustion chamber designed to provide 100 sq in. of floor area per gal of oil per hr burned, the nozzle temperature may run at, say, 150 F. That is a common figure. That same nozzle and burner installed in a combustion chamber designed to provide 60 sq in. of floor space per gal of oil per hr burned will increase the nozzle temperature to about 200 F. The reason for this change is that the radiating walls of the combustion chamber are much closer to the nozzle and, therefore, the amount of heat radiated to the nozzle will be increased, according to the laws of heat radiation.

From the above mentioned facts it will be evident that a nozzle designed to deliver 1 gal of oil per hr at room temperature will not deliver 1 gal of oil per hr at operating temperatures on some burners. It has been found that on some oil burners the nozzle temperature rarely, if ever, gets above 150 F. On other burners, especially if there is a condition of poor chimney draft or a positive pressure in the combustion chamber, temperatures will go considerably higher than those indicated, even up to 400 or 500 F. In those cases, extreme variations in the output of a nozzle will be experienced.

The pulsation, which is mentioned in the question, is apparently a separate problem and will not be dealt with here.—E. O. O.

VARYING OIL RATE WITH GUN TYPE BURNER

THIS IS IN reply to the Question of the Month submitted by "R. A." and published in the December HPAC, where he wanted to know why a gun type oil burner with a given size nozzle will deliver a varying rate of oil at a given pressure. This may be attributed to one of several conditions or a combination of these conditions. Some of the possible difficulties may be:

1) Air pockets in the oil line.
2) Dirt present in the nozzle.
3) Strainers dirty.
4) Poor ignition.
5) Inconsistent draft.
6) Pulsation.

The second part of "R. A.'s" question brings up the subject of proper and complete combustion. It might be well to state three points that are applicable to this subject of complete combustion, or in this case, the most efficient burning of liquid fuels:

1) The fuel oil must be delivered to the combustion chamber in a gaseous state.

2) The air for combustion must be admitted to enable a thorough mixing of fuel oil and air.

3) The combustion chamber must have sufficient volume and be formed so as to permit complete combustion.

It is with the third point that this second part of the question is concerned. A useful general rule that may be followed is that the volume of an oil burning furnace should be from 1.0 to 1.5 cu ft per lb of oil burned per hr. Thus, it may be seen that if the combustion chamber is too small, less oil is likely to be burned, which will be accompanied by the pulsating noise.

Some basic reasons for the pulsating noise are any one or more of the following:

1) Back pressure in firepot caused by insufficient draft.

2) Too heavy oil or too high flashpoint oil.

3) Dirty screen in nozzle or foreign substances in nozzle slots causing improper atomization.

4) Improper adjustment of ignition points causing intermittent ignition of oil at nozzle.

5) Improper shape and size of combustion chamber.

It may be readily seen that all of the above may be summarized into a general rule to follow when pulsation troubles are to be corrected with the use of a pressure burner. It involves the alteration of the combustion chamber size and/or shape and/or a readjustment of the burner and draft.—R. J.

FIGURING BTU LOAD FOR DRYING KILNS

I've been reading with interest the reply in each issue to the September question, What Amount of Heat for Two Dry Kilns? Of course, if this is a real problem [It is.—Ed.] the firm questioning must already have the answer and the equipment purchased—but let's not let it stop, for more of this sort of thing would be good for all of us.

In the October issue, "S. L." gave his answer and it's well thought out—but my experience with drying problems with air as the agent has been a little different. "S. L." states, "If air enters the kiln at 70 deg and leaves it at 70 deg, it must be warmed to about 137 deg." It is assumed this is not "bone dry" air, for nothing has been said of chemical dehydration. If air is the agent, and in this case it is, for the removal of water vapor the leaving temperature must be maintained above the entering temperature or its ability to absorb water is practically nil. In fact, under the most ideal conditions it is not a very good carrier. One cubic foot of air at any temperature will absorb and hold only about 2 grains of moisture.

Forgetting temperature for a moment, 40,000 cfm could pick up and remove about 80,000 grains of moisture. The two kilns in the problem each have a capacity of 32,000 lb of water per day. Placed on a 24 hr day (as "S. L." did) this amounts to 22 lb per min or 154,000 grains divided by 2 gives some 77,000 cfm.

I don't believe the assumptions should be made in the cfm in a problem of thermodynamics. The assumptions should be made in the Btu load of the project in question. These assumptions are cleared of all possible errors by careful study of the structure or apparatus, the production run (rate), and the type internal load, careful analysis being placed upon the entering and leaving temperatures of the materials. Bear in mind that the higher the final temperature that can practically be maintained the lower the cfm; and since air is rather difficult and expensive to move, economics are involved.

The type of hampers and crates to be dried might well stand a final temperature in excess of 200 deg. Since the boiling point of water is 212 deg, it would be less troublesome to maintain the final temperature above this point at, say, 215 deg. The fans should be placed on the after side as a draw through system results in better distribution over the product with less bother with baffles, etc.

There are too many questions left unanswered in the problem as stated. The complete Btu load can not be arrived at without knowing the correct hourly load rate, how the kiln is constructed, of what, and what final temperature the product will stand without spoilage.

"W. O.'s" solution in the December issue is quite simple indeed and very practical, but it does not answer the question adequately of how the calculation should be made. Since the problem has already carried over so many months, wouldn't it be well to have all the information so that a step by step calculation can be published to be filed away for future reference?

I believe "H. W." should come again with more information.—W. D. S.

Flexible metal hose conveys tar from the ground to the roof level

A pump at ground level supplies the tank and drawoff on the roof

ROOFERS PUMP TAR FROM GROUND LEVEL

A new roofing technique whereby tar is pumped through 1½ in. flexible metal hose from ground level to a tank on the roof is being employed by the Empire Roofing Co., Chicago. The pump used is a heavy oil type equipped with reduction gears. The scheme is said to make roofing procedures safer and to simplify the whole process.

The photos shown here (reproduced by courtesy of the Journeyman Roofer and Waterproofer) were taken during construction of an addition for the Appleton Electric Co. in Chicago, and show the pumping unit on the ground and the tank and drawoff on the roof.

HOW STOP CONDENSATION ON CONFECTIONERY WINDOW?

You are *invited to submit an answer to the following question from "W. L." for publication in these pages. Suitable answers will be paid for at regular rates, with additional payment for sketches. You are invited, too, to submit a question about heating, piping, or air conditioning for publication here.*

We are designing a modern confectionery store with a front almost entirely of glass, and the problem is how to prevent condensation on the glass in cold weather. There will be no show window back. The glass extends down to within 8 in. of the floor.

Double glass was considered but it cannot be obtained in the required size. The interior of the store will be air conditioned, which means that a certain amount of humidity will always be present.

Any suggestions on how to meet this problem would be greatly appreciated.—W. L.

Conductivities and Conductances of Building Materials and Insulations

DATA SHEET

By Paul D. Close

TABLE 3—CONDUCTIVITIES (*k*) OF VARIOUS WOODS*

These coefficients are expressed in Btu per hour per square foot per degree Fahrenheit temperature difference per inch thickness.

MATERIAL (Across Grain)	DESCRIPTION	DENSITY (lb. per cu ft)	MEAN TEMP. (F)	CONDUCTIVITY (*k*)	RESISTANCE (*R*)	AUTHORITY OR REFERENCE
Balsa		20.0	90	0.58	1.72	(1)
		8.8	90	0.38	2.63	(1)
		7.3	90	0.33	3.03	(1)
California redwood	0% moisture	22.0	75	0.66	1.53	(4)
	0% moisture	28.0	75	0.70	1.43	(4)
	8% moisture	22.0	75	0.70	1.43	(4)
	8% moisture	28.0	75	0.75	1.33	(4)
	16% moisture	22.0	75	0.74	1.35	(4)
	16% moisture	28.0	75	0.80	1.25	(4)
Cypress		28.7	86	0.67	1.49	(1)
Douglas fir	0% moisture	26.0	75	0.61	1.64	(4)
	0% moisture	34.0	75	0.67	1.49	(4)
	8% moisture	26.0	75	0.66	1.52	(4)
	8% moisture	34.0	75	0.75	1.33	(4)
	16% moisture	26.0	75	0.76	1.32	(4)
	16% moisture	34.0	75	0.82	1.22	(4)
Eastern hemlock	0% moisture	22.0	75	0.60	1.67	(4)
	0% moisture	30.0	75	0.76	1.32	(4)
	8% moisture	22.0	75	0.63	1.59	(4)
	8% moisture	30.0	75	0.81	1.23	(4)
	16% moisture	22.0	75	0.67	1.49	(4)
	16% moisture	30.0		0.85	1.18	(4)
Hard maple	0% moisture	40.0	75	1.01	0.99	(4)
	0% moisture	46.0	75	1.05	0.95	(4)
	8% moisture	40.0	75	1.08	0.93	(4)
	8% moisture	46.0	75	1.13	0.89	(4)
	16% moisture	40.0	75	1.15	0.87	(4)
	16% moisture	46.0	75	1.21	0.83	(4)
Longleaf yellow pine	0% moisture	30.0	75	0.76	1.32	(4)
	0% moisture	40.0	75	0.86	1.16	(4)
	8% moisture	30.0	75	0.83	1.21	(4)
	8% moisture	40.0	75	0.95	1.05	(4)
	16% moisture	30.0	75	0.89	1.12	(4)
	16% moisture	40.0	75	1.03	0.97	(4)
Mahogany		34.3	86	0.90	1.11	(1)
Maple		44.3	86	1.10	0.91	(1)
Norway pine	0% moisture	22.0	75	0.62	1.61	(4)
	0% moisture	32.0	75	0.74	1.35	(4)
	8% moisture	22.0	75	0.68	1.47	(4)
	8% moisture	32.0	75	0.83	1.21	(4)
	16% moisture	22.0	75	0.74	1.35	(4)
	16% moisture	32.0	75	0.91	1.10	(4)
Red cypress	0% moisture	22.0	75	0.67	1.49	(4)
	0% moisture	32.0	75	0.79	1.27	(4)
	8% moisture	22.0	75	0.71	1.41	(4)
	8% moisture	32.0	75	0.84	1.19	(4)
	16% moisture	22.0	75	0.74	1.35	(4)
	16% moisture	32.0	75	0.90	1.11	(4)
Red oak	0% moisture	38.0	75	0.98	1.02	(4)
	0% moisture	48.0	75	1.18	0.85	(4)
	8% moisture	38.0	75	1.03	0.97	(4)
	8% moisture	48.0	75	1.24	0.81	(4)
	16% moisture	38.0	75	1.07	0.94	(4)
	16% moisture	48.0	75	1.29	0.78	(4)
Shortleaf yellow pine	0% moisture	26.0	75	0.74	1.35	(4)
	0% moisture	36.0	75	0.91	1.10	(4)
	8% moisture	26.0	75	0.79	1.27	(4)
	8% moisture	36.0	75	0.97	1.03	(4)
	16% moisture	26.0	75	0.84	1.19	(4)
	16% moisture	36.0	75	1.04	0.96	(4)
Soft elm	0% moisture	28.0	75	0.73	1.37	(4)
	0% moisture	34.0	75	0.88	1.14	(4)
	8% moisture	28.0	75	0.77	1.30	(4)
	8% moisture	34.0	75	0.93	1.08	(4)
	16% moisture	28.0	75	0.81	1.24	(4)
	16% moisture	34.0	75	0.97	1.03	(4)
Soft maple	0% moisture	36.0	75	0.89	1.12	(4)
	0% moisture	42.0	75	0.95	1.05	(4)
	8% moisture	36.0	75	0.96	1.04	(4)
	8% moisture	42.0	75	1.02	0.98	(4)
	16% moisture	36.0	75	1.01	0.99	(4)
	16% moisture	42.0	75	1.09	0.92	(4)

(Concluded on next page)

TABLE 3—CONDUCTIVITIES (*k*) OF VARIOUS WOODS*

(Concluded from preceding page)

These coefficients are expressed in Btu per hour per square foot per degree Fahrenheit temperature difference per inch thickness.

MATERIAL (Across Grain)	DESCRIPTION	DENSITY (lb. per cu ft)	MEAN TEMP. (F)	CONDUCTIVITY (*k*)	RESISTANCE (*R*)	AUTHORITY OR REFERENCE
Sugar pine	0% moisture	22.0	75	0.54	1.85	(1)
	0% moisture	28.0	75	0.64	1.56	(4)
	8% moisture	22.0	75	0.59	1.70	(1)
	8% moisture	28.0	75	0.71	1.41	(4)
	16% moisture	22.0	75	0.65	1.54	(4)
	16% moisture	28.0	75	0.78	1.28	(4)
Virginia pine		34.3	86	0.96	1.04	(1)
West coast hemlock	0% moisture	22.0	75	0.68	1.47	(4)
	0% moisture	32.0	75	0.79	1.27	(4)
	8% moisture	22.0	75	0.73	1.37	(1)
	8% moisture	32.0	75	0.85	1.18	(4)
	16% moisture	22.0	75	0.78	1.28	(1)
	16% moisture	32.0	75	0.91	1.10	(4)
White pine		31.2	86	0.78	1.28	(1)
Yellow pine		..	..	1.00	1.00	(3)

*For additional data on the heat conductivity of wood see the following: Transverse Heat Conductivity of Wood, by Frederick F. Wangaard, ASHVE Journal Section, Heating, Piping & Air Conditioning, July 1940; Thermal Conductivity of Wood, by J. D. MacLean, ASHVE Journal Section, Heating, Piping & Air Conditioning, June 1941.

TABLE 4—CONDUCTANCES (C) OF FRAME CONSTRUCTION COMBINATIONS

These coefficients are expressed in Btu per hour per square foot per degree Fahrenheit temperature difference for thickness and construction stated.

MATERIAL OR DESCRIPTION	MEAN TEMP. (F)	CONDUCTANCE (*C*)	RESISTANCE (*R*)	AUTHORITY OR REFERENCE
1″ fir sheathing and building paper	30	0.86	1.16	(4)
1″ fir sheathing, building paper and yellow pine lap siding	20	0.50	2.00	(4)
1″ fir sheathing, building paper and stucco	20	0.82	1.22	(4)
Pine lap siding and building paper, siding 4″ wide	16	0.85	1.18	(4)
Yellow pine lap siding	..	1.28	0.78	(4)

References—see last column of tables:

(1) United States Bureau of Standards. (2) Tests conducted at University of Illinois by A. C. Willard, L. A. Harding, L. C. Lichty, and others. (3) Tests conducted at Illinois Institute of Technology (Armour Research Foundation), by J. C. Peebles. (4) Tests conducted at University of Minnesota, by F. B. Rowley, et al. (5) American Society of Heating and Ventilating Engineers Research Laboratory. (6) Tests conducted at Pennsylvania State College by Hechler and Queer. (M) Data from manufacturer; authority not stated.

CONDUCTIVITY AND conductance values have been compiled by the author from published sources and are given in Tables 1 to 11 inclusive. It will be noted that the values in Tables 1, 3, 6, 7, 8, 9, 10 and 11 are conductivities (k) and are therefore based on a 1 in. thickness of the material reported in each case. Tables 2 and 4 are conductances (C) and are for thicknesses other than 1 in. or for combinations of two or more materials. Table 5 contains both conductivity and conductance values. All coefficients express the rate of heat transfer between the material surfaces in Btu per hr per sq ft per deg Fahrenheit temperature difference per inch thickness (where the conductivity is given) or for some other thickness or combination of materials (where the conductance is given). Resistances (R) or resistivities, which are the reciprocals of the conductances or conductivities, are also listed, as well as the authorities in each case.

The tests were conducted by generally reliable sources. There is no certainty, however, that the figures for proprietary materials correspond with those for similar materials purchased in the open market. These and other pertinent facts should be considered when using these data.

Tables 1 and 2 were published last month. Tables 3 and 4 appear this month, and others will follow.

[Note: Mr. Close is technical advisor for Simpson Industries, Inc., sales division of the Simpson Logging Co. He was formerly technical secretary of the Insulation Board Institute, and before that was technical secretary of the American Society of Heating and Ventilating Engineers.]

Heating, Piping & Air Conditioning

AMERICAN SOCIETY of HEATING and VENTILATING ENGINEERS

Journal Section

Nature of Air Flow at Suction Openings

By Allen D. Brandt,* Russell J. Steffy, and Richard G. Huebscher****

This paper is the result of research carried on by the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, at its Research Laboratory located at 7218 Euclid Ave., Cleveland 3, Ohio in cooperation with the U. S. Public Health Service.

SUMMARY—Second progress report on investigation of air flow at suction openings. The results reported seem to substantiate the formula $Q = V(10X^2 + A)$ for centerline flow relationship for unflanged suction openings as given by DallaValle.

Introduction†

THIS paper is the second report of research investigations made by the Society in cooperation with the U. S. Public Health Service to provide fundamental data for those engaged in the design and construction of industrial exhaust systems. The first paper[1] reported the results of laboratory studies on the energy losses at the entrance to 175 different types of suction openings. Coefficients of entry to the hoods were calculated and the effects of various factors on the coefficient of entry discussed.

Dr. Brandt was assigned to the ASHVE Research Laboratory by the U. S. Public Health Service, from October 1945 to July 1946; the Committee on Research provided the technical assistants and equipment.

Other parts of the overall research program are under way at the Laboratory and elsewhere under the guidance of a committee of engineers experienced in the field of industrial atmospheric sanitation. The results will be reported to the membership as the program progresses. Comments and suggestions from members and others will be welcomed. They should be addressed to the ASHVE Research Laboratory, 7218 Euclid Ave., Cleveland 3, Ohio.

Previous Studies

The importance of local exhaust ventilation in industrial atmospheric sanitation has been recognized for many years. It was not until about 1930, however, that the nature of air flow at suction hoods was studied in an attempt to develop fundamental relationships between the shape, size and type of hood; the velocity *in front of the hood*; and the volume rate of air flow through the hood. Possibly the most comprehensive and the first of such investigation was undertaken by DallaValle[2], and most of his findings are in common use today by designing engineers. He reported that the relationship between axial velocity in front of freely suspended unflanged hoods and the quantity ventilation rate through the hoods is expressed with sufficient accuracy for all practical purposes by the equation[3].

$$\frac{Y}{100 - Y} = 0.1AX^{-2} \qquad (1)$$

where Y = percent of face velocity found at distance X

A = face area of hood in square feet

X = axial distance in feet from hood face to point where velocity is Y

This equation converted to the form commonly used is [4, 5, 6].

$$Q = V(10X^2 + A) \qquad (2)$$

where Q = quantity rate of air exhausted through the hood in cubic feet per minute

V = velocity in feet per minute at axial distance X in feet from face of hood

X = distance in feet from face of hood to point where velocity is V

A = area of hood face in square feet

DallaValle used a special Pitot tube[7] to measure the air velocities in his study. This is a velocity-pressure type instrument and requires a very sensitive pressure gage and extreme care to measure velocities as low as 120 fpm. The development of the heated - thermometer anemometer about 1935 resulted in a velocity measuring device which permitted the measurement of much lower velocities with comparative ease[8]. In the early forties Silverman, using the heated-thermometer anemometer, attempted to extend DallaValle's earlier studies into the lower velocity range[9]. He, like DallaValle, found that the centerline velocity relationship can be expressed accurately only by complex equations but that it can be stated with sufficient accuracy for all practical purposes by an equation of the form used by DallaValle, namely:

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†Cyril Tasker, Director of Research ASHVE.

‡Exponent numerals refer to Bibliography.

Presented at the 53rd Annual Meeting of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, Cleveland, Ohio, January 1947.

$$\frac{V}{V_o - V} = KAX^{-2} \qquad (3)$$

where V = centerline velocity in feet per minute at distance X in feet from the face of the hood

V_o = average velocity in feet per minute at the face of the hood

K = constant

A = area of hood face in square feet

X = centerline distance in feet from face of hood to point where velocity is V

For unflanged freely suspended hoods Silverman found the value of K to be 0.225, which, when used in Equation 3, may be converted to the more common form as follows:

$$Q = V\,(4.45\,X^2 + A) \qquad (4)$$

Where Q, V, X and A are the same as in Equation 2.

A glance at Equations 2 and 4 shows that they will give widely different results;—over 100 per cent difference for many values of X and A. For example, the exhaust rate required to produce a velocity of 100 fpm at a distance of 9 in. from a freely suspended 4-in. diameter duct end is 570 cfm by DallaValle's equation and 260 cfm by Silverman's. These results pose a serious problem for the engineer who designs local exhaust systems since he must decide whether to use Equation 4 with the advantageous lower exhaust rate but the possible disastrous result of inadequate control, or to use DallaValle's data and be criticised for the high exhaust rate and heating load in cold weather.

Present Study

The present study was undertaken to find out which, if either, of these equations is correct and to provide the engineer with the factual information needed to design systems which will work effectively. The test arrangement was the same as described in Bibliography[1]. Velocity measurements in front of the hoods were made with two types of Pitot tubes and a heated-thermometer anemometer. The three instruments were not used to measure the velocity at each point studied but were used at sufficient points to determine whether the results obtained by them were comparable. Some of the pressures when using the Pitot tubes were measured with ordinary inclined U-tube manometers, some with a two-liquid differential gage and some with a commercial type of inclined gage. The one tube, designated the special Pitot tube, was similar in many respects to that used by DallaValle[7]. It was made by cutting a 1/8 in. outside diameter piece of copper tubing at an angle of about 45 deg, sealing the hole in each piece of the tubing, soldering the copper tubes together again, and drilling a hole in each portion of the tube so that the holes were essentially opposite each other and facing in opposite directions (see Fig. 1). The other tube, designated the small Pitot tube, was a scale model of the standard Prandtl instrument and had a tube diameter of only about 1/16 in. at the end with the pressure holes.

The instruments were calibrated in a wooden tunnel as described in Bibliography[8]. It is interesting to note that the special Pitot tube used in this study produced a pressure reading 1.78 times the true velocity pressure; a figure which agrees very well with the 1.60 to 1.75 reported by DallaValle for his special Pitot tube. After the study had been completed the calibration of the instruments was checked in free air, as will be described later.

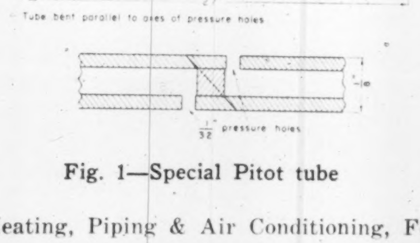
See detail below
27"
Tube bent parallel to axes of pressure holes
$\frac{1}{32}$" pressure holes

Fig. 1—Special Pitot tube

Since it was the purpose of this investigation to study only the axial or centerline flow relationship, readings were made only on the axial line of the hoods at 2, 3, 4, 5, 6, 9, 12, 15, and 18 in. from the faces of the hoods. The middle of the bulb of the heated-thermometer, the middle of the special Pitot tube at the pressure holes, and the static holes of the small Pitot were located at the point in question as carefully as possible without the use of special mechanical devices for centering them. The small Pitot tube was employed just as if an ordinary velocity pressure reading were being made but the static holes were located at the point where the velocity was to be measured and only the pressure produced by the static holes was measured.

Unflanged Hoods

A total of 9 unflanged hoods was studied. Details on the size and shape of these hoods are given in Table 1.

Table 1—Unflanged Hoods Studied

Hood No.	Shape	Throat Dia. In.	Face Dimensions In.	Included Angle (deg)
1	Round	8	8 dia.	0
2	Round	4	9 dia.	40
3	Round	8	11.3 dia.	50
4	Round	8	18 dia.	58
5	Round	12	27 dia.	40
6	Round	4	4 dia.	0
7	Square	8	16 x 16	45
8	Rect.	8	11 x 22	54 and 12½
9	Rect.	8	8 x 31½	107 and 0

Six round, one square, and two rectangular hoods comprise the group. Duct ends and flared hoods were also investigated.

The data obtained for each hood were plotted on log-log paper as shown, for example, in Figs. 2, 3, and 4, and the equation in the form

$$\frac{V}{Vo - V} = \frac{KA}{X^n} \qquad (5)$$

was then derived from the *curve of best fit*. The values of K and n for each hood are listed in Table 2 in which the hood numbers are the same as in Table 1. It is apparent from the table that the values for round openings are of the same order of magnitude as for rectangular and square hoods, and the results are applicable, therefore, to all of the usual shapes of

Table 2—**Values of *K* and *n* in Equation $\frac{V}{V_0 - V} = \frac{KA}{x^n}$ for Unflanged Hoods**

Hood No.	*K*	*n*
1	0.0854	2.230
2	0.1220	1.915
3	0.1090	2.000
4	0.1170	2.000
5	0.1300	1.950
6	0.0950	2.110
7	0.1260	2.280
8	0.0876	2.000
9	0.0915	1.810
Average	0.1071	2.033

unflanged exhaust hoods. The data given in Table 2 indicate that the axial flow relationship may be expressed by the equation:

$$Q = V(9.35X^{2.03} + A) \quad \text{.......(6)}$$

This checks rather well with that derived by DallaValle, and it seems reasonable to conclude, therefore, that the convenient equation

$$Q = V(10X^2 + A),$$

which is in common use today, may continue to be used by designing engineers for unflanged freely suspended round, square, or rectangular exhaust hoods of the usual types.

Before proceeding with the other parts of this investigation, it may be well to consider the physics of air flow into suction openings to see whether the foregoing relationship appears reasonable. It is obvious, of course, that if a point source of suction could be created, the air would flow into that point equally from all directions, and the velocity contours would be spherical surfaces. Since the area of the surface of a sphere is $4\pi r^2$, the air flow relationship would be:

$$Q = 4\pi r^2 V = 12.57 r^2 V \quad \text{........(7)}$$

where Q = the quantity rate of air flowing into the point source of suction in cubic feet per minute

r = radius in feet of the spherical surface at any point in which the air velocity is V feet per minute

V = the velocity in feet per minute at any point in the spherical surface r distance in feet from the point source of suction

When air is moving into a hood or pipe opening under suction these theoretical conditions do not prevail

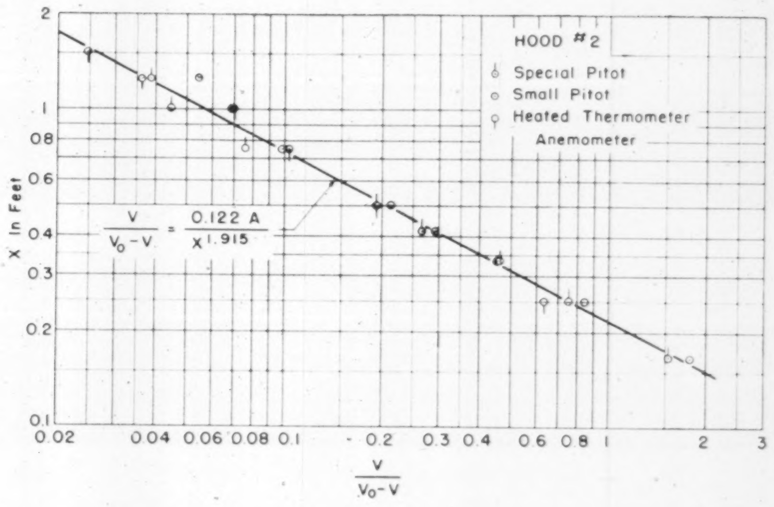

Fig. 2—Centerline flow relationship for hood No. 2

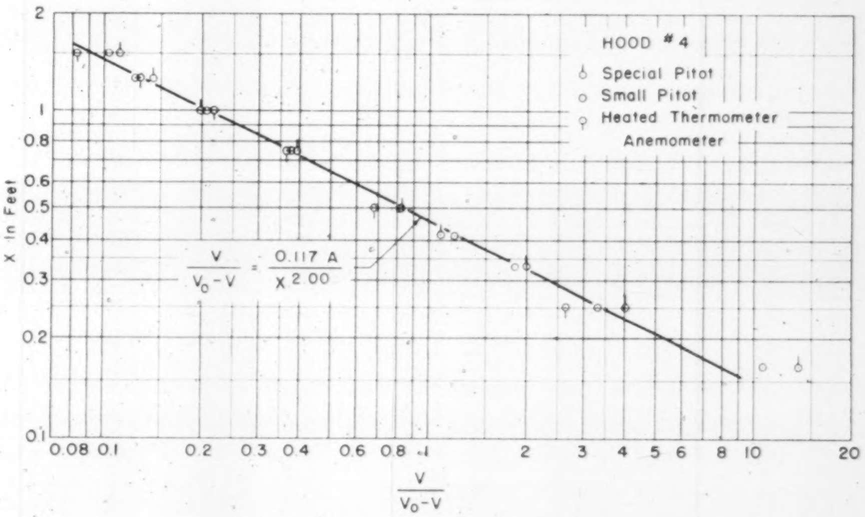

Fig. 3—Centerline flow relationship for hood No. 4

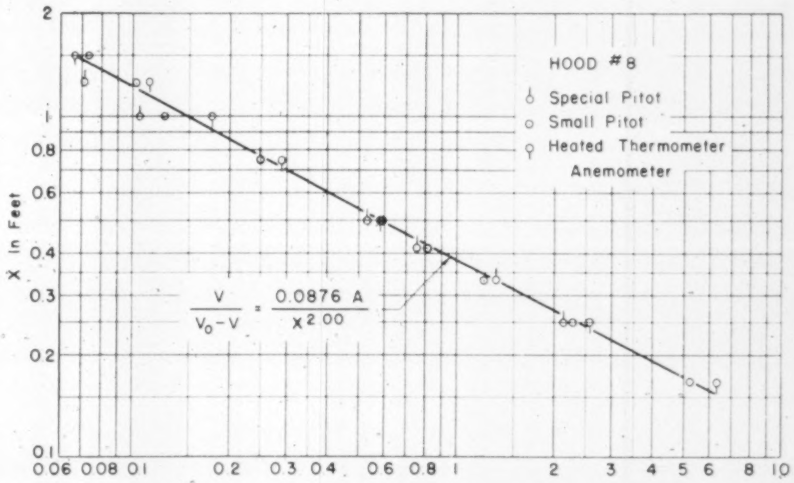

Fig. 4—Centerline flow relationship for hood No. 8

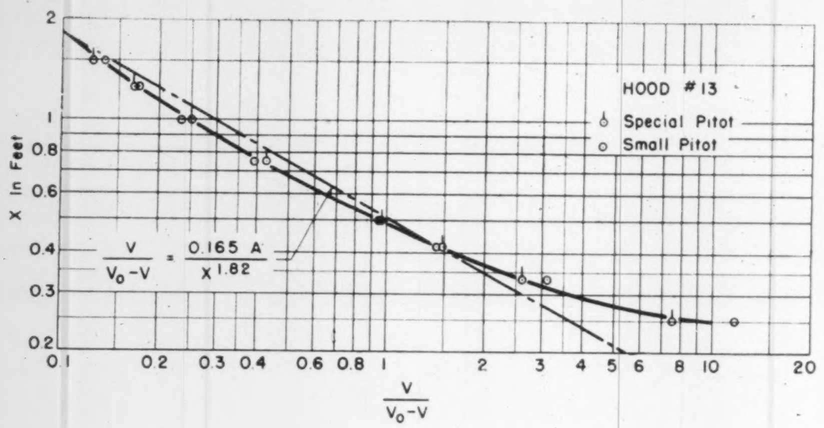

Fig. 5—Centerline flow relationship for hood No. 13

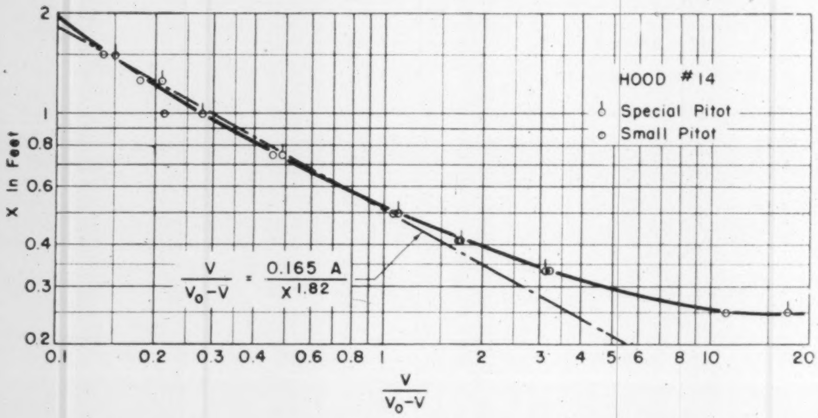

Fig. 6—Centerline flow relationship for hood No. 14

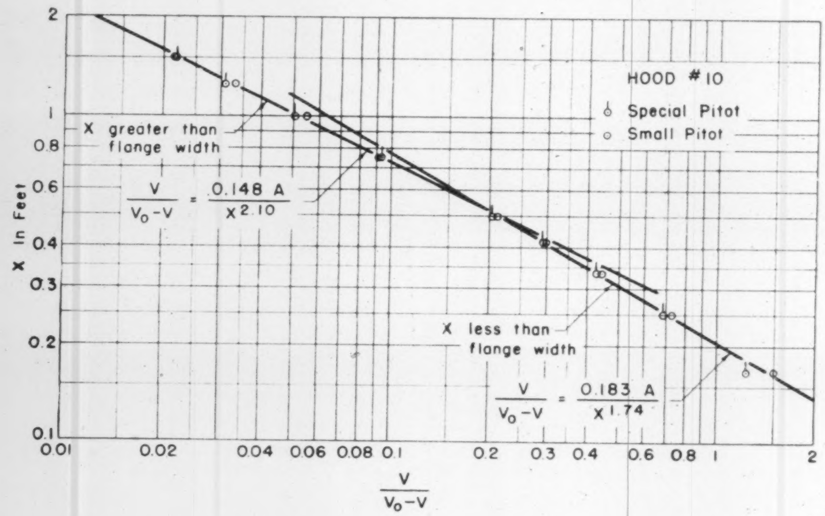

Fig. 7—Centerline flow relationship for hood No. 10

Table 3—Flanged Hoods Studied

Hood No.	Shape	Throat Dia. In.	Face Dimensions In.	Included Angle (deg)	Flange Size In.	Dist. hood edge to flange edge In.
10	Round	8	8 dia.	0	24 x 24	8
11	Round	8	18 dia.	58	48 x 48	15
12	Square	8	16 x 16	45	48 x 48	16
13	Square	8	16 x 16	45	24 x 24	4
14	Square	8	16 x 16	45	32 x 32	8

but it is reasonable to assume that with a small diameter pipe end, for instance, the velocity contours would be almost spherical in shape and would have their centers approximately at the point formed by the intersection of the axis of the pipe with the plane of the face of the opening. To make Equation 7 applicable to all conditions even if r becomes zero, as would be the case if the velocity were measured in the face of the hood, a correction factor must be inserted in the area portion $(12.57r^2)$ of the equation. This condition is met if A representing the face area of the hood is included in the existing area factor because the equation then becomes $Q = AV$ when r is zero. Equation 7 now becomes:

$$Q = V(Kr^2 + A),$$

In which K is somewhat less than 12.57

Since X of Equations 2 and 4 is the same as r of Equation 7, it becomes:

$$Q = V(KX^2 + A) \qquad (8$$

where, Q, V, X and A are the same as in Equation 2

K = some value less than 12.57

Since the contours are not truly spherical surfaces, as was the case with the theoretical conditions, the constant as well as exponent of X will probably change but it seems likely that Equation 8 should represent fairly closely the true relationship. For the constant in this equation to decrease substantially, it is necessary that the contours in front of suction openings elongate considerably in an axial direction. Since this seems unlikely, it appears that Equation 2 should be more nearly correct than Equation 4.

Flanged Hoods

Three flanged hoods (one with three different size flanges) were also investigated. Details on these hoods and flanges are given in Table 3. Airflow relationship data were plotted on log-log paper similar to that for unflanged hoods. A straight line was found to fit the points for two hoods Nos. 11 and 12 but not for the other three. The points obtained for hoods Nos. 13 and 14 defined curves (see Figs. 5 and 6) while those obtained for hood No. 10 appear to define two different straight lines (see Fig. 7). While the data are too few to permit

Table 4—Comparison of Measured Velocities at Flanged Hoods with those Computed by $Q = V\ (6.06X^{1.82} + A)$

Hood No.	Velocity at different distances from hood face															
	3 In.		4 In.		5 In.		6 In.		9 In.		12 In.		15 In.		18 In.	
	Meas.	Comp.[a]	Meas.	Comp.[a]	Meas.	Comp.[a]	Meas.	Comp.[a]	Meas.	Comp.[a]	Meas.	Comp.[a]	Meas.	Comp.[a]	Meas.	Comp.[a]
10	2905	2970	2133	2125	1591	1570	1211	1200	597	625	352	381	218	257	150	187
11	1139	1200	956	1050	817	906	703	780	467	505	316	343	212	246	173	185
12	1396	1175	1142	1020	943	885	802	762	494	494	325	336	218	241	161	182
13	1354	1185	1110	1030	887	893	732	768	435	498	293	339	216	243	172	183
14	1355	1150	1106	1000	917	866	758	745	467	483	285	329	236	235	183	178
Avg. dev. (%)		10.2		7.5		4.9		3.7		6.1		10.3		12.4		10.7

[a]Computed from equation given at top of table.

conclusions, they suggest that a straight line relationship will exist with flanged hoods if the flange width is not less than the distance from the face of the hood to the point where the velocity is measured, but that such relationship will not exist if the flange width is small as compared to the distance X.

The data suggest also that the air flow relationship for flanged hoods is expressed by the following equation so long as X is not larger than the flange width:

$$Q = V(6.06X^{1.82} + A) \qquad (9)$$

Even though the results obtained for hoods 10, 13, and 14 do not define straight line relationships the use of Equation 9 will obtain results sufficiently accurate for practical purposes for all flanged hoods (see Table 4).

Since Equation 9 is not particularly convenient for every-day use, it may be desirable for designing engineers to use the equation for an unflanged hood (No. 11) and to make appropriate corrections for flanges. Thus the value of Q as determined by Equation 2 may be reduced as much as 35 per cent if the hood is equipped with flanges at least as wide as the distance X in the equation. For narrower flanges the percentage reduction should be decreased proportionately.

A rectangular unflanged hood having face dimensions of 8 in. x 31½ in. was investigated when lying on a large table top to simulate conditions in industry when hoods are used at work benches. The hood was No. 9 and had one of the long sides in contact with the table top. Since this hood was studied also as a freely suspended unflanged hood, the results may be compared to demonstrate the improvement produced by the adjacent table top (see Table 5). It is interesting to observe the different equations resulting from these studies. For the freely suspended unflanged hood the centerline flow relationship was found to be:

$$Q = V(10.9X^{1.81} + A),$$

and when the hood was adjacent to the table top the relationship was:

$$Q = V(5.3X^{1.67} + A)$$

Table 5—Influence of Large Flat Surface Adjacent to Long Side of Rectangular Hood

Dist. from hood face in In.	Centerline velocity in feet per minute	
	Hood freely suspended	Hood on table
2	1353	1511
3	1081	1185
4	798	990
5	641	862
6	520	695
9	332	507
12	163	364
15	123	275
18	89	212
Equation of flow	$Q = V(10.9x^{1.81} + A)$	$Q = V(5.3x^{1.67} + A)$

Comparison of Velocity Measurements

Even though there was no conspicuous and consistent discrepancy apparent between the readings obtained by the different instruments while the data were being collected, during analysis of the data it appeared that the velocities read with the heated-thermometer anemometer were higher than those read with the two Pitot tubes in the low-velocity range. To study this observation further a significant number (54) of points at which the velocity had been measured with the three instruments were selected at random and divided into convenient velocity ranges which would give fairly even distribution of the readings among the groups. The recorded velocities in each group were then averaged for each instrument. These results are summarized briefly in Table 6 from which it can be seen readily that if it is assumed that the true velocity is that recorded by the small standard Pitot tube, the

Table 6—Comparison of Results Obtained with Special Pitot (Sp.P), Small Standard Pitot (SSP) and Heated-Thermometer Anemometer (HTA)

	Less than 300 fpm (Avg. of 21 readings)			300 to 600 fpm (Avg. of 18 readings)			Over 600 fpm (Avg. of 15 readings)		
	Sp.P	SSP	HTA	Sp.P	SSP	HTA	Sp.P	SSP	HTA
Avg. velocity in fpm	170	189	212	434	441	468	1179	1215	1123
Sp.P coefficient based on SSP results	1.44			1.71			1.68		
Per cent of HTA from SSP			+12.2			+6.1			−7.6

coefficient of the special Pitot tube is lower in free air (average 1.61) than in a tunnel (average 1.78), and the heated-thermometer anemometer in free air gives high results in the low-velocity range and low results in the high range; the percentage of error increasing as the velocity range decreases.

The lower coefficient of the special Pitot tube may be due in part also to the lower average velocity encountered in free air. This agrees with the findings of Ingram[10] and others that in unconfined air near suction openings, pressure tubes (special Pitot tubes) read progressively lower as the velocity decreases and progressively higher as the velocity increases when compared with the heated-thermometer anemometer[10]. Apparently on the assumption that the true velocity was given by the heated-thermometer anemometer, these authors attributed this phenomenon to changing coefficient for the tubes tested.

It was realized at the initiation of these tests that there might be discrepancies between the results obtained from the readings of the several instruments used. However, since the tests were being made to investigate variations of the order of 100 per cent, extremely precise instrumentation was not considered to be essential.

To serve as a double check on the findings, particularly in the low velocity range, the instruments were recalibrated in free air. A new and, perhaps, useful air-flow arrangement was devised for this purpose.

Calibration in Free Air

To approximate the conditions obtaining if a point source of suction were possible, a hollow copper sphere, 6⁷⁄₁₆ in. in diameter, was drilled full of ¼ in. holes. A 4-in. diameter hole was then cut in the copper ball and it was attached to a 4-in. diameter pipe. A collar, in the shape of a frustrum of a cone, was then fitted around the pipe where the copper sphere was attached, in such fashion that it formed the extension of the cone produced by the imaginary surface formed by drawing lines from the center of the sphere to the circumference of the 4-in. circle where the pipe and ball joined (see Fig. 8). Since the resistance to air flow through the holes in the copper sphere was considerable, this ball became in effect a very large point source of suction except for the portion attached to the pipe. When air was exhausted through the copper sphere, uniform air flow toward the ball was created in the entire spherical zone beyond the ball with the exception of the portion cut off by the collar. Obviously, then, if extraneous air currents could be eliminated the velocity contours would be portions of spherical surfaces and the true velocity at any distance from the copper sphere could be computed accurately for any volume rate of air flow.

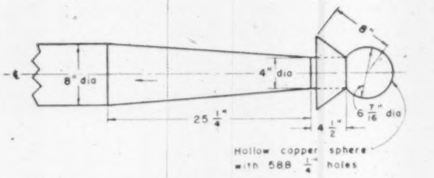

Fig. 8—Test device for checking instrument calibration

Preliminary tests indicated that it was practically impossible to eliminate extraneous air currents entirely, so readings were taken at five different stations around the sphere and averaged to give the measured velocity at that distance from the copper ball. These stations were above and below the ball in its vertical axis, at each side of the ball in the horizontal axis parallel to the face of the 4-in. pipe, and in front of the ball in the centerline of the 4-in. pipe. Velocity measurements were made at 2 in., 3 in., 4 in., and 6 in. from the copper sphere with the special Pitot and the small Pitot, and a few readings were taken at 4 in. and 6 in. with the heated-thermometer anemometer. The velocity at 6 in. was too low to give trustworthy results with the small Pitot tubes and these results were discarded. The data obtained with the two Pitot tubes are summarized in Table 7 from which it is apparent that the small Pitot tube gives remarkably accurate results in free air. The greatest error in the velocity measured with this instrument appears to be only 2.8 per cent and the average error for the three distances is only 1.8 per cent. The coefficients of the special Pitot tube for the four different distances are 1.66, 1.64, 1.61, and 1.30. These values, in conjunction with those given in Table 6, indicate that the coefficient of the special Pitot in free air decreases as the velocity decreases. Only a few readings were obtained with the heated-thermometer anemometer and conclusions, therefore, are not warranted. The few measurements which were made indicated that this device was reading in the order of 20 per cent high at 4 in. and 6 in. from the copper sphere.

Conclusions

The results of this investigation appear to substantiate DallaValle's findings and suggest an explanation for the widely different results reported by Silverman. The centerline flow relationship at unflanged suction openings is expressed with sufficient accuracy for practical purposes by the convenient equation $Q = V(10X^2 + A)$. No similar convenient and fairly accurate equation is applicable for flanged openings. The equation $Q = V(6X^{1.8} + A)$ may be used for flanged hoods, but it is more convenient to use the unflanged relationship and to correct the results for flanging.

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Table 7—Calibration Check of Two Pitot Tubes in Free Air

Dist. from sphere In.	Computed	Velocity in feet per minute											
		Special pitot						Small standard pitot					
		Reading station					Avg.	Reading station					Avg.
		1	2	3	4	5		1	2	3	4	5	
2	553	474	560	533	549	552	534	489	585	557	578	585	558
3	389	333	387	354	392	398	373	365	411	371	419	415	396
4	253	234	246	237	237	246	240	238	242	242	247	259	246
6	155	143	151	117	127	122	132	—	—	—	—	—	—

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8. The Heated-Thermometer Anemometer, by C. P. Yaglou. (*Journal Industrial Hygiene and Toxicology*, 1938, Vol. 20, p. 497.)

9. Centerline Velocity Characteristics of Round Openings Under Suction, by L. Silverman. (*Journal Industrial Hygiene and Toxicology*, 1942, Vol. 24, p. 259.)

10. The Characteristics of Double Pitot Tubes, by F. R. Ingram, E. Diez-Canseco and L. Silverman. (ASHVE Journal Section, *Heating, Piping & Air Conditioning*, November 1942, Vol. 14, p. 702.)

Appendix

Shortly after the foregoing article was completed a report of a similar study made on one hood of much larger size came to the authors' attention. This report was prepared by Knowlton J. Caplan and gives the results of a post-graduate research project which he carried out at Michigan State College during the Spring and Summer term of 1946. The hood he studied was 8 ft square with one edge on the floor and 15-in. wide flanges at the other three sides.

It is not the intent of this Appendix to report or discuss the findings of this investigation, but merely to cite two interesting trends in the results which parallel trends in the authors' data; trends which were either not mentioned or not stressed owing to paucity of data. These tendencies will now be mentioned for what they are worth. More research is needed to substantiate or refute these findings. The following data are included in this paper with the permission of Prof. L. G. Miller, Michigan State College, and Mr. Caplan, Michigan Department of Health.

Caplan also used three velocity measuring instruments but the only device common to both studies was the heated-thermometer anemometer. His other two instruments were the Alnor Velometer and a rotating vane anemometer. The calibration of the instruments was not checked by Caplan; the manufacturer's calibrations were used throughout. In Table 8 are summarized the air velocity determinations at all points where readings were taken with the three instruments—all centerline readings. The results in Table 8 are arranged somewhat similar to those in Table 6 for convenient comparison. It is apparent from Table 8 that while the magnitude of the deviations of the heated-thermometer anemometer values from those given by the other instruments is not the same as shown in Table 6 the trend is unmistakable.

If these trends are correct, Silverman's findings as given in Bibliography[9] might likely be due to high velocity values obtained with the heated-thermometer anemometer since most of his reported velocity readings were less than 100 fpm; a range where the true velocity might well have been only about one-half as high as reported. As stated previously, more data are needed to establish or invalidate this suggested trend.

The other similarity noticed in the results of these two reports is the influence of flanges on the centerline velocity relationship to the quantity rate of exhaust through the hood. When Caplan's readings were plotted as shown in Figs. 2 to 7, the points within the zone of influence of the flanges appear to define a straight line, and beyond this zone of influence define a different straight line (Fig. 7); the breakpoint being at a distance from the hood which is greater than the flange width but smaller than the distance from the center of the hood face to the edge of the flange. Whether this suggested characteristic is correct and what relationship there is between the breakpoint and the flange or flange plus hood width cannot be determined from the few results reported in Caplan's report and the authors' paper. More research is needed also on this point.

Discussion

Leslie Silverman,* Boston, Mass. (Written): The writer is very much interested in this article since it involves certain data which were obtained in this laboratory several years ago.

In fitting our data we favored a dimensionless equation of the form

$$\frac{V}{V_o} = K\left(\frac{X}{\sqrt{A}}\right)^n$$

since this problem is essentially one of fluid dynamics. It will be noted that we cited limits of $\frac{X}{\sqrt{A}}$ between 0.5 and 3.0 for our measurements. In applying DallaValle's function to our data the values of the exponent on X varied from 1.4 to 2.5, so that any equation fitted was obviously very approximate—Dr. Brandt's work confirms this fact.

A study of the data presented in Table 2 by Brandt, Steffy and Huebscher shows the approximation of their data. Thus in Table 2, if we take the values of K for a constant exponent $n = 2.00$ we get:

Hood Number	K	n	Deviation from DallaValle's constant $K = 0.1$ Per Cent
3	0.1090	2.00	+ 9.0
4	0.1170	2.00	+17.0
8	0.0876	2.00	−12.4

Hood 5 may be included also since its exponent is very close (within 2½ per cent of 2), or

5	0.1300	1.950	+30.0*

*This value assumes $n = 2$ for hood 5 with the value of K cited.

Table 8—Comparison of Results Obtained with the Velometer (*V*), the Rotating Vane Anemometer (*RVA*) and the Heated-Thermometer Anemometer (*HTA*)

	100 to 150 fpm (Avg of 8 rdgs)			150 to 200 fpm (Avg of 6 rdgs)			200 to 300 fpm (Avg of 3 rdgs)			300 to 400 fpm (Avg of 2 rdgs)		
	V	*RVA*	*HTA*	*V*	*RVA*	*HTA*	*V*	*RVA*	*HTA*	*V*	*RVA*	*HTA*
Avg vel in fpm	118	99	138	169	153	178	263	238	253	385	324	312
Deviation of *HTA* from *RVA*			+39%			+16%			+6%			−4%
Deviation of *HTA* from *V*			+17%			+5%			−4%			−19%

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*Assistant Professor of Industrial Hygiene, Harvard School of Public Health.

In the foregoing values, if DallaValle's constant of $K = 0.1$ is employed for reference it can be seen that Brandt's deviation varies from —12.4 per cent to +30 per cent. In view of these wide differences it seems unnecessary to express values of K and n to 4 places, as in Table 2 of this article, especially since the curves are those of best fit *by eye* and not by using the method of least squares. Further, the points plotted in Figs. 2 to 7 show differences which would only warrant n being expressed to the nearest tenth, and K to the nearest hundreth.

In using the DallaValle type of equation two important facts must be stated which we emphasized in our paper. When the distance X from the hood is zero, Equation 2 reduces to $Q = AV$ where V is the centerline velocity. In only frictionless air flowing into a perfect hood or bell-mouth opening with a flat contour and no turbulence on entrance would this be correct. The actual centerline velocity at the mouth as shown by our data may be as high as twice the average face velocity V_o, since an unflanged plain opening does not flow full. In our work we had difficulty in reproducing velocity measurements close to the mouth because of the unstable turbulent conditions. It is evident that the centerline velocity at the mouth will exert some influence on the velocity along the centerline. Thus in our Fig. 2 (See Bibliography[9]) it can be seen that for a 20 in. pipe opening the point velocity is not reduced to that of Q/A until 5 in. from the opening.

Because of the vortex at the pipe mouth it is obvious that the equation proposed by DallaValle gives erroneous results close to the opening.

The second fact which must be borne in mind is that at infinite distance ($X = \infty$) the velocity is not zero, as given by this type of equation, but is equal to the extraneous air currents, since these are always present in the atmosphere of industrial operations. We feel that the latter condition may have influenced our results since measurements were made at distances as great as 40 in. from the opening. At this distance the actual velocities measured were only slightly above room air currents. The heated thermometer which was employed is an integrating instrument and therefore is influenced by the turbulence or any factor which contributes to heat loss from the heated thermometer bulb.

In other studies, Brandt's test results with the thermo-anemometer agreed reasonably well with ours. It would appear from these data that the differences must be instrumental as he suggests. In an article† published previously he presents data on a slot type hood with the heated thermometer anemometer. If one measures his velocity contours and calculates the quantity flowing, the results obtained are:

Actual quantity exhausted, cfm	1320
Measured value from plotted contour, 300 fpm	1650
Measured value from plotted contour, 200 fpm	1650
Measured value from plotted contour, 150 fpm	1650
Measured value from plotted contour, 100 fpm	1740

These values, then, indicate quantities determined from velocity readings to be 25 to 32 per cent higher than the actual metered pipe flow. A similar study‡ of data reported on the same type of hood by another laboratory using the heated thermometer shows results indicating that contour values are as follows:

Actual quantity exhausted, cfm	1000
Measured value from plotted contour, 200 fpm	1300
Measured value from plotted contour, 100 fpm	1475

These values indicate a variation of 30 to 47.5 per cent above the actual exhausted quantity.

Three different laboratories (four if Caplan's results are included) thus have obtained high values independently when using the heated thermometer anemometer (our values for hoods fall into this category since we obtained deviations of approximately +40 per cent as discussed earlier). It would appear, then, that the heated thermometer anemometer deserves further investigation. In this study Brandt shows heated thermometer readings which average as high as 20 per cent above other measuring instruments using his calibration method, therefore the writer would like to comment on these discrepancies.

The heated thermometer anemometer is an integrating instrument and measures essentially heat loss created by air movement. This air movement may be due to turbulence as well as linear motion of air. Pitot tubes measure point velocity, and in front of openings only static pressure at a point is measured. To date, heated thermometer anemometers have been calibrated in wind tunnels and good agreement has been obtained on duplication of these calibrations by other observers□. No one has attempted to compare calibrations made outside an opening under suction where the flow is presumed to be streamline, nor has it been possible to calibrate the thermo-anemometer with rotating arm devices (thermocouples might be used for this purpose). Fundamentally, then, the instrument should be calibrated under conditions similar to those actually used. The heated thermometer is also susceptible to stem immersion correction. In Brandt's Table 6 he compares random selected values and indicates high readings at less than 300 fpm, and 300 to 600 fpm, and low readings above 600 fpm. Since no mention is made, the writer wonders whether any attempt was made to correct for stem immersion on any of these readings. Yaglou (see Bibliography[8]) shows that the stem immersion correction may be as high as 30 per cent; that is, uncorrected readings are from 0 to 30 per cent lower than actual, depending upon the indicated velocity and depth of immersion. Corrections are necessary for all velocities above 100 fpm. Thus in Brandt's Table 6 some values may be influenced by immersion. Only at large openings or substantial distances where the contour is flat can the stem be subject to the same velocity as the bulb. Therefore, in these authors' sphere calibration procedure the actual deviation of the heated thermometer may be even greater than +20 per cent, and the values in Table 6, last column, may be positive rather than negative. In our work we tried to correct for immersion by several means, as reported in Bibliography[9].

It thus appears that the differences in velocities may be because the heated thermometer is non-directional, whereas point velocity devices are directional.

Before concluding, the writer would like to comment on other phases of this paper. In his comments on the sphere concept, Brandt considers his reflections on the *physics* of air flow into openings. In our opinion the discussion which follows is *geometry* and not physics. This concept disregards viscosity and density, assumes a perfect fluid, and also neglects turbulence and vortices at the opening. The vortices at the pipe entrance may elongate the contours near the opening because the centerline velocity is accelerated by the restricted opening produced by vortical flow. This may not be of any importance at substantial distances from the inlet. The sphere theory is a simple concept and valuable for explanation purposes to laymen, but it does disregard the existing fluid dynamics near the entrance.

The sphere method of calibration proposed in this paper may be open to some criticism. It assumes, as in the sphere discussion given by Brandt, that calibrations are made with a perfect fluid, which is not the case. If this simple technic is feasible, why bother with rotating arms and similar devices for calibrating instruments in free air? Also, if such a calibration procedure is acceptable for a standard why go to the extreme of making a sphere? Isn't a long narrow slot with cylindrical contours more desirable and simpler to construct? A slot also has the advantage that measuring instruments are completely immersed, as is necessary in the case of the heated thermometer anemometer, and that the velocity varies directly with distance, making positioning of instruments less critical.

In conclusion the writer would like to state that he is reconciled to the use of DallaValle's equation with due regard for its limitations and since it does refer to point measurements. From the practical standpoint its use allows adequate safety precaution for contingencies. Because of obvious approximations in fitting measured data and some discrepancy in double pitot tube coefficients, its accuracy is not very good. I believe that further work on the heated thermometer anemometer for measurements in front of openings is again indicated by this study.

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†Ventilation of Plating Tanks, by Allen D. Brandt. *(Heating, Piping & Air Conditioning,* July, 1941, p. 434.)

‡New Data for Practical Design of Ventilation for Electroplating, by William P. Battista, Theodore Hatch and Leonard Greenburg. *(Heating, Piping & Air Conditioning,* February, 1941, p. 81 and June, 1941, p. 365.)

□ASHVE RESEARCH REPORT No. 1140—The Use of Air-Velocity Meters, by G. L. Tuve, D. K. Wright, Jr., and L. J. Seigel. (ASHVE TRANSACTIONS, Vol. 45, 1939, p. 645.)

Human Tolerance to Heat

by Willard Machle, M.D., New York, N.Y.

SUMMARY — Recent studies of thermal exchanges of man are presented in relation to the concept of thermal equilibrium. The significance of the equilibrium concept in the design of experiments on thermal exchange is indicated as is the relationship to the establishment of permissible thermal environments for work.

Introduction

It is the author's intention to review some of the newer knowledge of man's reaction to high temperatures, and suggest certain avenues for future study. The material to be presented deals largely with work carried out at the Armored Medical Research Laboratory, Fort Knox, Ky., during the years 1942 through 1945. In presenting these results the author would like to be considered merely as spokesman for the group which carried out the work. The ventilation, heating, and cooling of working environments is often a compromise between two opposing demands; *first,* to provide a working environment that will keep personnel fit to work and in satisfactory state of health; *second,* the requirement to maintain conditions necessitated by operations, material or equipment. Military requirements of recent years have largely determined the direction of investigations of thermal physiology. Certain of these studies bear directly upon industrial problems, and progress in the field has pointed up certain practical considerations which must enter into the design of any future investigations of human thermal exchange.

Thermal Equilibrium

A concept, recently more fully explored, is that of human thermal equilibrium. The overall pattern of thermal equilibrium and exchange at normal temperatures has already been well-defined and described earlier. The results obtained from extension of study to the higher levels of thermal stress near the limits of human tolerance have, however, served to clarify further the character of the equilibrium phenomenon. From many past studies, such as the systematic investigations of the John B. Pierce Laboratory of Hygiene and the Russell Sage Institute, it has been evident that no rigid equation can fully describe thermal relations under all conditions. The physical laws, however, remain applicable when all variables are properly included. Before beginning discussion of thermal equilibrium and for the purpose of review, it would be well, therefore, to consider the basic equation of heat balance as developed by the Pierce Laboratory.

$$M+D-V = +R+C+E \ldots (1)$$

where

M = metabolic rate
D = rate of change of body heat content
R, C and E = rate of heat exchange with environment by radiation, convection and evaporation
V = rate of heat exchange by respiration

The terms to the right can be rewritten as coefficients of exchange and as gradients.

$$M'+D = K_r\,A(t_s\text{-}t_w)+K_cA\ (t_s\text{-}t_a) +K_eA\ (P_s\text{-}P_a) \ldots\ldots\ldots (2)$$

where

$M' = M-V$
A = body surface area
T_s = average skin temperature
T_w = mean radiant wall temperature
t_a = air temperature
P_s = vapor pressure water at temperature t_s
P_a = vapor pressure moisture in air (= per cent R H x P at t_a)
K_r, K_c, and K_e, = coefficients of heat exchange by radiation, convection and evaporation

Temperature and vapor pressure gradients can be determined by direct measurement. The coefficients, however, are not predictable from physical relationships and must be determined experimentally.

Inspection of Equation 2 indicates that change in body heat content will be reflected in changes of magnitude of D, the equation therefore being applicable at all times, whether the subject is in steady or changing thermal state. It is a common observation that body temperature increases in a hot environment as it does during work. With slight increases in ambient temperature the rise in body temperature may not be great. Nonetheless, within rather wide ranges of increase in temperature, body temperature rises progressively until a new equilibrium is established and a steady state achieved (provided the subject remains in the environment and his normal homeostatic processes for thermal adjustment are adequate). The length of time required to approximate the new equilibrium state is given in the following expressions:

$$D = SW\,(a\,\Delta\,t_r+b\,\Delta\,t_s) \ldots (3)$$

where

S = specific heat of body
W = body weight
$\Delta\,t_r$ and $\Delta\,t_s$ = rates of change of internal and skin temperatures
a and b = weighting factors which proportion body heat in relation to internal and skin temperatures

A heat balance equation can be written:

$$-\frac{SW}{A}(a\,dt_r+b\,dt_s)=\Big[M'+K_r t_w +K_c t_a+K_e\frac{A_e}{A}(45+P_a) -(K_r+K_c+2.5K_e)\,t_s\Big]d\Theta \ldots (4)$$

where

dt_r, dt_s = differential changes of body and skin temperature
A_e = effective area for evaporation
$d\Theta$ = differential time interval

Assuming body and skin temperature to be mutually dependent, for a limited range:

Presented at the 53rd Annual Meeting of the American Society of Heating and Ventilating Engineers, Cleveland, Ohio, January 1947.

$$dtr = ndt_s$$

In a given situation the terms

$$\left[M' + K_r t_w + K_c t_a + K_e(45 + P_a) \right.$$

and

$$\left. (K_r + K_c + 2.5\ K_e) \right] \text{ are constant.}$$

Calling these C and C' it follows that:

$$-\frac{SW}{A}(an+b)\int_{t_o}^{t_e} \frac{dt_s}{C - C'\,dt} = \int_o^{\infty} d\Theta \ldots\ldots\ldots\ldots (5)$$

which gives

$$\frac{t_e - t_s}{t_e - t_o} = C \ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

where

t_o = initial skin temperature
t_e = new equilibrium skin temperature
t_s = skin temperature at time Θ

The Equations 5 and 6 have the form of the common law of equilibrium and the time required to reach any given percentage of equilibrium can be calculated provided the values for the various factors are known. Equation 5 is a reasonably close approximation of the time situation despite the limited knowledge of the magnitude of certain factors in Equation 5, especially *a*, *b* and *n*.

The foregoing expression is, of course, an oversimplification; but closely approximates the true situation, as found in experiments carried out at Fort Knox, where the temperature rise curves were found to be exponential and approached equilibrium at the same rate for all environmental conditions, varying from moderate to extreme. The curves yielded an average exponent of 1.08 Θ.

With respect to future work it is apparent that the time rate of approach to equilibrium is an important factor in any experimental design; short term experiments carried out during the changing state being of limited value. The thermogeography of the body is variable and it becomes difficult to evaluate different factors until the steady state is reached.

The concept of equilibrium is further important in the consideration of the upper limits of tolerance to heat. Body temperature does not continue to rise as the patient remains in an environment, but rises to a new equilibrium dependent upon the man's ability to maintain equilibrium at the higher level.

Permissible Thermal Environments for Sustained Work

The concept of equilibrium offers a new tool in the approach to the difficult problem of what constitutes permissible thermal environment for work. It would be very convenient and helpful if there were some yardstick or threshold value for permissible thermal conditions in industry, and there have been numerous attempts to establish such on the basis of laboratory investigation and empirical practice. This problem is a complex and difficult one. In the first place, there is no entirely satisfactory method of expressing equivalents of environments at levels of high thermal stress; and secondly, any criterion of equality implies the measurement of a group of complex physiologic factors, which when taken together will be used to estimate the strain.

Practically all factors which influence environmental stress, heat dissipation, heat production, or the fitness of man, become qualifying variables when any attempt is made to define the limits at which man may be employed. Of the environmental factors which must enter into any consideration of permissible level are air temperature, duration of exposure, air movement, radiation, clothing, constancy of stress, and opportunity for intermittent relief. The individual factors which will influence any interpretation are: the health and fitness of the man, the level of work and heat production, body size, degree of acclimatization, age, posture, fatigue, state of hydration, salt intake, caloric intake, and a number of other factors. It is apparent from the number and kind of variables, many of which have been given no quantitative evaluation, that any threshold or critical value for environmental conditions must either be given a wide margin of safety or be accepted as being valid only under strictly limited conditions of the experiments. One requires, therefore, before any position can be taken for permissible limits, considerably expanded study under controlled conditions for evaluation of these many variables. With the advancing mean age of the industrial worker, certain of the above factors, such as age and fitness, become of increasing importance and should have high priority in any program of investigation.

Even if the analytic approach is ignored and attention is turned to the study of the capacity of the whole man and the range of his attributes with respect to tolerance of temperature, employing a statistical approach, there is still an investigative problem of considerable magnitude, in that it is essential to find out what constitutes an acceptable range of increase in equilibrium level of body temperature. So far, it has not been possible to correlate increases in rectal temperature, even within rather wide limits, with deterioration in performance. Such criteria as have been suggested, such as a 1½ Fahrenheit degree rise in rectal temperature, may not be accepted without additional supporting data from industry or long-time laboratory experimentation. From experience at Fort Knox it has been shown that men can and do work at rates of 300 calories (1190 Btu) per hour or more for periods as long as four hours, with rectal temperatures of 103 F or higher, without ill effects. Conversely it has been repeatedly observed that disabling heat exhaustion may occur without rise in rectal temperatures, or with increases of fractions of a degree only. The problem requires continued investigation with especial attention to individual factors and to the nature and rates of deterioration with continued exposure.

Response and Lag in the Control of Panel Heating Systems[†]

By F. W. Hutchinson,[*] Lafayette, Ind.

SUMMARY—This paper describes a panel heated test house which is in service on the Purdue University Research Housing Campus. The five-room residence is equipped with four independent sinuous-coil type hot-water panel systems located in the floor, ceiling, exterior walls, and interior partitions. Five different methods of controlling the panel heating are installed and have been tested. All tests reported in this paper are for ceiling panels *only* and were conducted with constancy of living room air temperature as a criterion of control; if optimum comfort had been the criterion, the inside air temperature would have had to be varied as an inverse function of load.

Introduction

A FIVE ROOM residential-type structure, specially designed for use as a panel heating and cooling *laboratory*, has been equipped and is under test on the Housing Research Campus of Purdue University. The building, shown in Fig. 1, is not occupied and is reserved exclusively for use in carrying on basic research on the characteristics of panel heating and the relative performance of various types of panel systems.

Four separate panel systems are installed in each of the rooms. As shown in Fig. 2, a photograph taken during construction, sinuous coil type panels are located in the floor, the ceiling, the exterior walls, and the interior partitions. Each of these four systems can be used independently of the others and each has sufficient capacity to carry the entire heating load. Coils located in the floor are embedded in concrete whereas all others are embedded in plaster in accordance with usual construction procedures. Flow meters permit determination of the rate of circulation of hot water through any coil in any room while a totalizing meter gives the gallons per minute of warm water circulating through the system as a whole.

In the living room the ceiling coils are so arranged that alternate tubes discharge into different headers (see Fig. 3). By manipulation of valves in the lines discharging from the panel (valves shown below left center of Fig. 3) it is possible, in effect, to double the tube spacing in the ceiling. Further, a valve is located in the supply header to the living room ceiling in such a position (see Fig. 4) as to permit taking part of the panel area out of service. Thus the living room ceiling can be used as a heating surface of either of two areas and of either of two coil spacings. For all tests discussed in the present paper the living room was used as the criterion of control and only the ceiling panel (full area with minimum tube spacing) was in service.

Energy for the heating system is provided from a gas-fired flash-type boiler as shown in Fig. 5. When the boiler operates in conjunction with a recirculating system using a three-way mixing valve to blend water from the boiler with water returning from the panels the flow rate through the boiler is, of course, a variable with load; under such conditions boiler water temperature is maintained at a fixed temperature (within the limits of the controller) and the burners operate on an off-on sequence as may be required to hold the boiler water temperature at the arbitrarily selected setting. Four solenoid-operated gas valves (two of which can be seen near the bottom of the boiler in Fig. 5) act simultaneously when the boiler is operating as described.

When the mixing valve is out of service and all water from the system passes through the boiler, control of the burners is under the direction of a thermostat located in the living room. For one type of control system, an off-on thermostat is used to simultaneously open or close all four gas valves whereas with another control system a modulating thermostat actuates the four valves in sequence. The cam shaft which controls the switches that operate the solenoid valves is shown on top of the boiler—just below the flue—in Fig. 5. In the same figure a flow meter is partially visible behind the flue and the indicating and

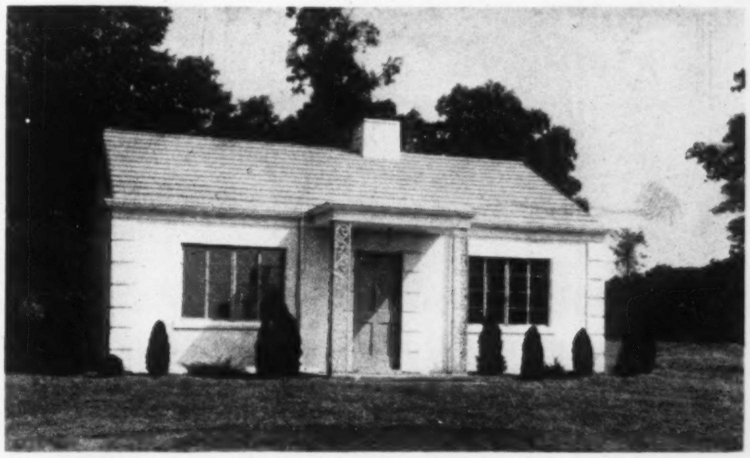

Fig. 1—Test house for study of panel heating and cooling at Purdue University

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[*] Professor of Mechanical Engineering, Purdue University. Member of ASHVE.

[†] A progress report resulting from a research project on panel heating being conducted at Purdue University under a grant from the *Copper and Brass Research Association;* This paper was prepared in cooperation with the Housing Research Foundation: G. Stanley Meikle, Research Director; Carl F. Boester, Housing Executive.

Presented at the 53rd Annual Meeting of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, Cleveland, Ohio, January 1947.

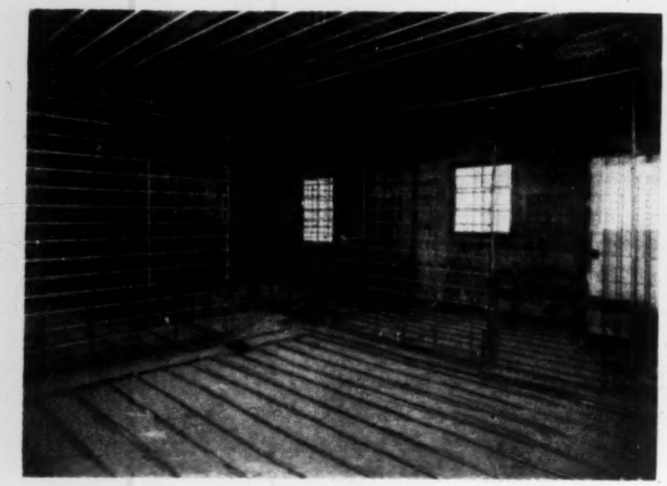

Fig. 2—Location of panel systems in test house

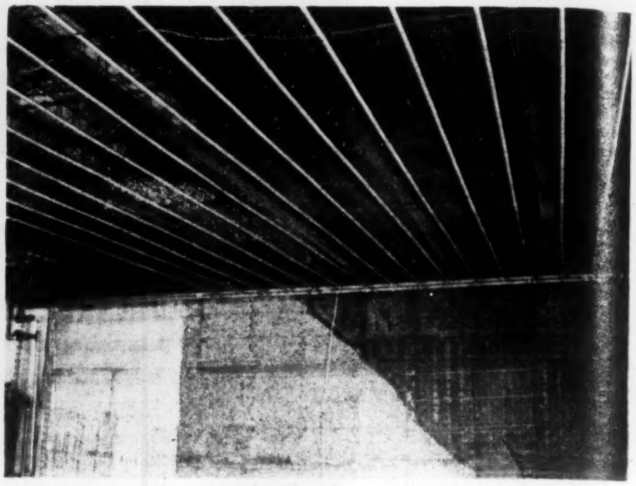

Fig. 3—Arrangement of living room ceiling coil for variation of tube spacing

recording meter for total flow of water to the system is shown on the wall. In all tests discussed in this paper the flow rates were 5 gpm and 1 gpm for the system and for the living room, respectively.

All doors and windows of the living room were sealed except a door to an adjoining bedroom. Outside air was introduced into the living room at a rate of 1½ air changes per hour and escape of this air occurred through the unsealed door. The problem of control for the living room was accentuated due to the fact that the front of the house faces south and two unshaded living room windows in this wall (see Fig. 1) receive unobstructed sunshine during all the morning hours and partially obstructed sunshine (due to grille supports of the portico) during the afternoon. The roof of the house is at an angle such that solar irradiation of the part over the living room—the south east section—is abnormally great. Hence the influence of solar load as a factor in determining panel heating control characteristics is probably greater for the living room of this test house than it would be for most rooms of an average house of non-solar construction.

Throughout the duration of all tests the temperatures of air, water, and surfaces were determined by means of thermocouples and recorded automatically. Fig. 6 shows the control station with a master panel for all thermocouples in the house and plugs to permit selecting the 32 thermocouples that are to be recorded—two of four available recorders are shown in the figure. Also evident in Fig. 6 is a manual potentiometer for checking purposes and to permit determination of readings from thermocouples that are not attached to the recorders; under the table is an ice bath which has been used in all tests in preference to cold-junction compensation. The control station is located in the *kitchen*, adjacent to the boiler room; when a test is in progress all equipment operates automatically so the operator need not enter any room of the house except to change flow charts once in 24 hours; under no conditions does anyone enter the living room during the test period. Most tests have been of 60 hr duration and the shorter period selected for use in this report is in

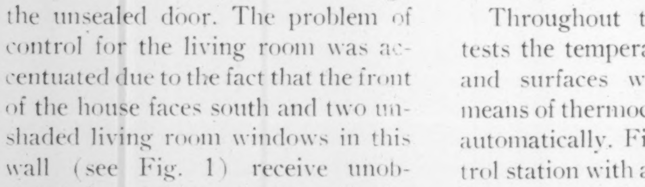

Fig. 4—Arrangement of living room ceiling coil for variation of panel area

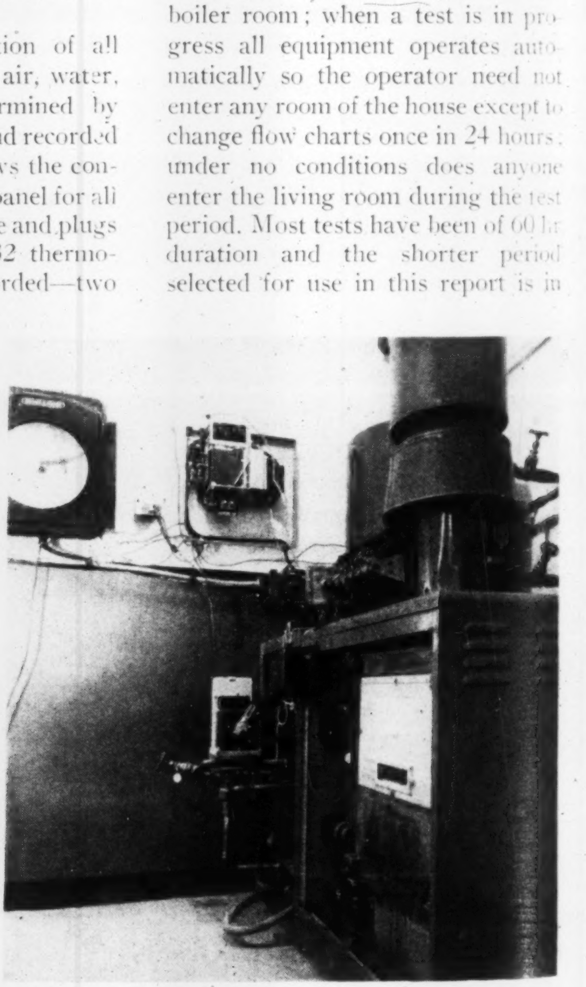

Fig. 5—Boiler and controls

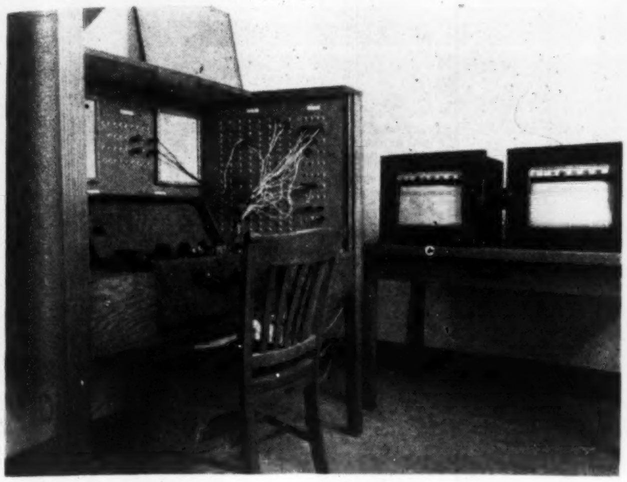

Fig. 6—Temperature indicating and recording station

each case taken from a region near the middle of the 60 hr. Except where otherwise noted no test results are accepted until their consistency has been verified by at least one additional test period during which the same performance characteristic is observed.

Five Control Systems

The experimental work reported in this paper gives the performance, with living room air temperature at the breathing level as a criterion, of five different systems which were used for controlling the energy supply to the panels. The effectiveness of each system can be evaluated in terms of its ability to achieve a rapid rate of panel response and a minimum magnitude of deviation from the fixed control point. It must be emphasized that the purpose of this research has been to study response and lag factors in control of panel systems and that the selection of fixed air temperature as a criterion of effective control should not be construed as implying that fixed air temperature would be a desirable condition in a practical installation. These tests are *not* comfort tests hence it was not necessary to require that *comfort* conditions (necessitating variation of air temperature with load) be maintained within the room. For research purposes an adequate control system is one that will permit maintenance of arbitrarily assumed conditions; for practical purposes an adequate control system is one that will permit maintenance of the air temperature-mean radiant temperature relationship expressed by the Comfort Equation (sum of these two temperatures to be constant and equal numerically to 140 F). But any control system that will satisfy research requirements will also satisfy practical comfort requirements provided some device or method is employed to cause the control point (as expressed by inside air temperature) to vary as a function of load.

In some commercial equipments comfort conditions are approximated by re-setting the inside air control point as a function of outside air temperature. This method assumes that outside air temperature varies as a lineal function of load hence is inexact due to neglect of the influence of wind effect, solar irradiation, and internal load; the deviation is frequently not great and in some cases it appears to offer a curiously effective means of achieving what amounts, for certain seasons, to automatic night set-back of the room air temperature.

Of the five systems tested three used living room air temperature as the basis of control, one used outside air temperature, and the other used a combination of inside and outside air temperatures. Thus,

I. Control Systems Actuated by Room Air Temperature.

1. The first system—reported as Test No. 1—used an off-on thermostat actuating simultaneously all four gas valves ahead of the burner. With this arrangement, shown in Fig. *7a*, all water going to the panels passes through the boiler; (the pump operates continuously for all systems)

2. The second system differs from the first only in that a modulating room thermostat replaces the off-on one and the four gas valves are actuated in sequence. Adjustment of cams permits spacing the control point of each gas valve at any desired point over the temperature range through which the thermostat provides modulation. The flow diagram for this arrangement is the same as for the first case (Fig. *7a*).

3. Test No. 3 (Fig. *7b*) is based on recirculation of water returning from the panels with parallel by-passing through the boiler of a fraction sufficient to provide a blend—at discharge from the three-way mixing valve—at whatever temperature may be needed to carry the load. Except for minor fluctuations due to difference in resistance between the main line and the by-pass, the total flow rate is constant, but the flow rate through the boiler varies with load. Temperature of water leaving the boiler is held at an arbitrarily fixed value by off-on operation of the burners under control of a temperature sensitive element in the pipe at boiler discharge. The three-way valve is actuated by a temperature sensitive element at discharge, the setting of which is reset, through relays, under the control of the modulating thermostat in the living room. All experimental work reported for Test No. 3 (as also for tests 4 and 5) is based on a fixed boiler water temperature setting of 120 F; the design value of this temperature for the heating system is 150 deg., but as the tests reported here were all run in periods of

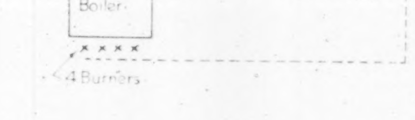

Fig. 7a

Test 1. Off-on thermostat actuates four burners simultaneously

Test 2. Modulating thermostat actuates four burners in sequence

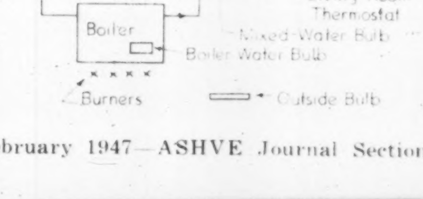

Fig. 7b

Test 3. Boiler water bulb actuates burners; modulating room thermostat re-sets mixed-water bulb which actuates mixing valve; outside bulb not used

Test 4. Outside bulb re-sets mixed-water bulb which actuates mixing valve; boiler water bulb actuates burners; thermostat not used

Test 5. Outside bulb re-sets mixed-water bulb and setting is partially corrected by room thermostat; boiler water bulb actuates burners

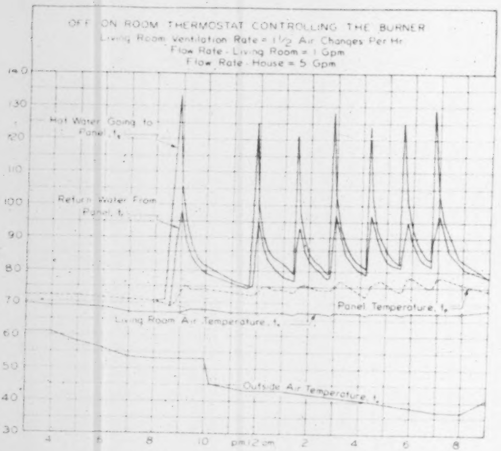

Fig. 8a—Results from Test No. 1

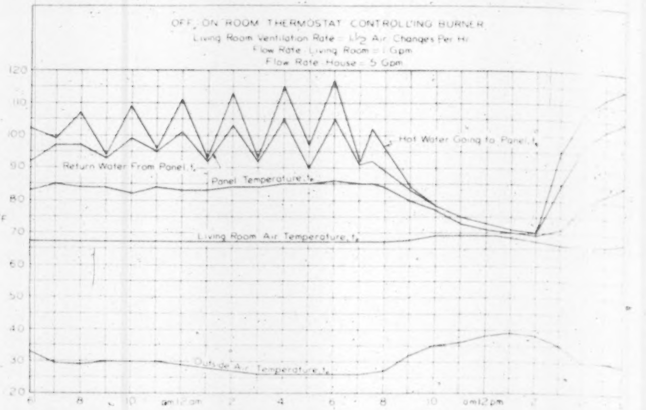

Fig. 8b—Time-temperature curves of leaving and return water are here incorrectly plotted to illustrate text discussion; *do not include in analysis*

moderate load a more favorable three-way valve operating range was obtained by lowering the setting.

For the foregoing tests an arbitrary thermostat setting at 67 F was selected. With the thermostats used, however, it was found that the control point, for a fixed scale reading, varied somewhat between tests even though the average heating load was the same for the two test periods. To avoid confusing this characteristic of the thermostat with performance characteristics of different control systems the experimental results have been slightly shifted in scale, for tests where this is necessary, to indicate 67 F as the room temperature setting. Since the doors of all rooms of the house were kept closed circulation of air between rooms did not occur at a normal rate and maintenance of 67 F in the living room does not, therefore, mean that temperatures in all other rooms were at the same value. Actually, no particular care was exercised to adjust other rooms to a balanced condition, yet the temperature variations from room to room were not great. These temperatures have nothing to do, however, with the effectiveness of a given control system in maintaining a fixed air temperature within a particular zone hence they are not given further attention in this paper. In later tests consideration will be given to the separate problem of determining the accuracy with which a five room one-story panel heated house can be treated as a single control zone.

II. Control System Actuated by Outside Air Temperature (Test No. 4).

This system is shown diagrammatically in Fig. 7*b*, the outside temperature sensitive element replacing the room air thermostat in fixing the setting of the bulb which determines the position of the three-way valve. Experiment showed that on a cloudy day with 35 F air temperature the necessary temperature of water to the system was 105 F. The equivalent comfort temperature within the room was defined as 70 F (allowing for a raised mean radiant temperature to offset the 3 F depression of room air temperature) so with 70 F outside air the water temperature should be 70 F. Assuming a straight line relationship between water temperature and outside air temperature (an assumption which implies that outside air temperature determines heating load), this would mean that at 0 F outside the required water temperature would be 140 F. Thus, a 70 F drop in outside temperature corresponds to a 70 F rise in water temperature and the controlling condition is therefore that the sum of outside air temperature and water (to the system) temperature must at all times be equal to 140 F. For the experimental work reported in Test No. 4 this desired relationship was not realized, so part at least of the departure of inside air temperature from the control point must be attributed to performance of the control system rather than to thermal lag in the structure.

III. Control System Actuated by Outside Air Temperature with Limited Re-Set from Inside Air Temperature (Test No. 5).

The flow diagram for this system is similar to Fig. 7*b*, the outside temperature sensitive element setting the water temperature exactly as in Case II, but the inside air thermostat possessing re-set ability over a plus or minus 7 F range of water temperature. Thus a correction can be applied for solar load, wind load, or internal source load up to 14/70 or 20 per cent of the total maximum heating load.

Performance of the Control Systems

Figs. 8 through 12, respectively, give test results from each of the five control systems which have been described. Representative test periods have been selected in each case and the same temperatures are plotted on each figure; these are,

1. Outside shaded air temperature, t_o.

2. Air temperature, t_a, 5 ft above the floor in the center of the living room.

3. Mean temperature, t_p, of the surface of the heating panel which occupied the entire living room ceiling. Thermocouples are installed on 2 ft centers over the surface of the panel and, although point-to-point variation does occur, experience with the system has led to determination of a single thermocouple so located that its reading closely approximates the average of all the others.

4. Water temperature, t_r, of returning fluid.

5. Water temperature, t_s, of fluid going to the system. In every case this temperature was determined by a thermocouple located on the discharge side of the three-way valve; for tests in which all water passed through the boiler this reading would, of course, correspond to the boiler water temperature.

Test No. 1: Direct Water Heating with Burner Control by Off-On Thermostat. The data for this test (Figs. 8*a* and 8*b*) show remarkable constancy of room air temperature except during periods for which solar gain rapidly and materially reduces the load. Fig. 8*a* shows that during the twelve-hour period from 9 p.m. to 9 a.m. the outside temperature dropped 16 F, but the inside air temperature remained within 1 F (½ F for the greater part of the time) of the control point. Thus response of the system to sudden and substantial load change—as represented by the 8 F drop in outside temperature that accompanied a thundershower at 10 p.m. and occurred in less than 15 min—is rapid and does not allow undue departure from the control point.

From the standpoint of thermal capacity of the panel it is interesting to note that the lag effect is to provide an excellent damping characteristic. Thus between midnight and 7 a.m. the boiler cycles once in approximately 1½ hr with a periodic variation in leaving water temperature of 40 F, yet the corresponding periodic change in mean panel surface temperature is only ⅛ as great. The lag effect of the panel is clearly evident in that the maximum panel surface temperature usually occurs close to half an hour after the water temperature reaches its maximum value, that is, half an hour after the thermostat has been satisfied and has cut off the burner. If minimum panel temperature lagged minimum air temperature by a like amount the control would not be nearly so effective, but the figure shows that the heating-up curve for the panel (as for the water) is much steeper than the cooling curve hence response of the panel surface temperature to warmer water occurs instantly.

From the foregoing discussion it would appear that some optimum relationship exists between the available excess boiler capacity and the heat capacity of the panel. Since the excess energy output of the panel decreases as the heating load increases one would expect a flatter heating-up curve in cold weather and a greater lag in response of the panel surface to action by the room thermostat. Thus, in time of heavy load, the droop of panel surface temperature below the equilibrium value would be large and the overshoot of this temperature would be small, while in time of light load the opposite would occur.

This operating characteristic brings out an interesting fact with respect to the use of a fixed air temperature in a panel heated room. If perfect control were achieved neither panel droop nor overshoot would occur and by the conditions of the comfort equation the room would be too hot under heavy load and too cool under light load. To establish comfort, with such a control system, the thermostatic setting should be lowered under high load and raised for low load. But, if this theoretically desirable change of setting is used with a cycling system of the type of Test 1, the room would be too cool during heavy load and too hot during light load. Thus, it follows that, fortuitously, the imperfection in control due to change, with load, in the slope of the heating curve serves to provide partial compensation, from the comfort standpoint, in a room for which the air temperature is not adjusted as a function of load. In any room with periodically varying panel surface temperature, conditions of optimum comfort cannot be realized, but the droop and overshoot characteristics will at least serve to lower the equivalent panel surface temperature under heavy load and to raise it during light load.

Note, Fig. 8*a*, that between 3 p.m. and 8 p.m. the heat was not on and the room temperature exceeded the control point. This condition probably is attributable to solar gain through the two unshaded living room windows.

Fig. 8*b* shows performance of the same control system when the outside air temperature remained practically constant over 24 hours. Periodicity of panel surface temperature no longer is as pronounced, but the influence of sunshine between the hours of 8 a.m. and 2 p.m. is very definite. The plottings of water temperatures in Fig. 8*b* have been made on an hourly basis and it is at once evident, by comparison with the water temperature curves of Fig. 8*a*, that an hourly plotting of periodic fluctuations is very unsatisfactory and may readily be responsible for erroneous concepts concerning performance of the system. Thus, in Fig. 8*b* the lines connecting hourly water temperatures imply alternate heating and cooling, within the temperature limits shown on the curve, of the boiler water. From a consideration of the shape of the curves of Fig. 8*a*, it is evident, however, that the 8*b* curves may be erroneous in magnitude, in slope, and in time of cycle. From an hourly temperature plot one cannot determine whether the temperature at each point is rising, falling, or at a point of inflection. Thus, when periodic variation occurs the temperature-time plotting should be between points of maximum and minimum rather than for equal time increments; the water temperature curves of Fig. 8*b* are, therefore, shown here merely to demonstrate the hazards of such a plotting and they should not be used in analysis of system performance.

Test No. 2: Direct Water Heating with Burner Control by Modulating Thermostat. To reduce the amount of overshoot of panel surface temperature a modulating thermostat can operate the burner valves in sequence and thereby reduce the slope of the heating curve to any desired value. It will be noted, however, that excess slope reduction would result in droop of panel surface temperature with consequent over-cooling of the room. Fig. 9 shows that the slope of the heating curve with sequence operation of the burners is much less than when off-on control (Fig. 8*a*) is used and the slope always starts to fall off before the thermostat is satisfied; this is in contrast with the results of Test 1 for which the cut-off of the burners occurred during the period of high rate of water temperature rise.

The droop of panel surface temperature for the sequence control is not of great magnitude—averaging less than one degree—but the time lag is close to 15 min in contrast

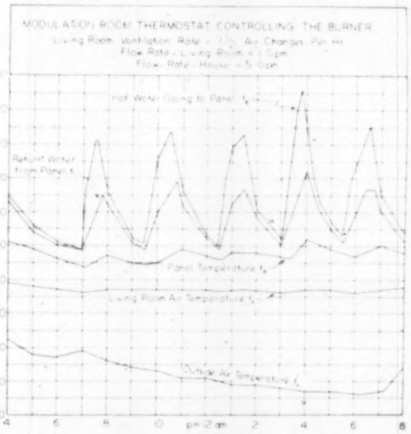

Fig. 9—Results from Test No. 2

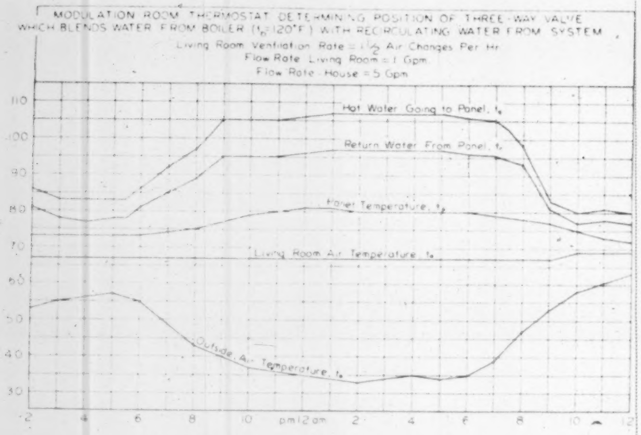

Fig. 10—Results from Test No. 3

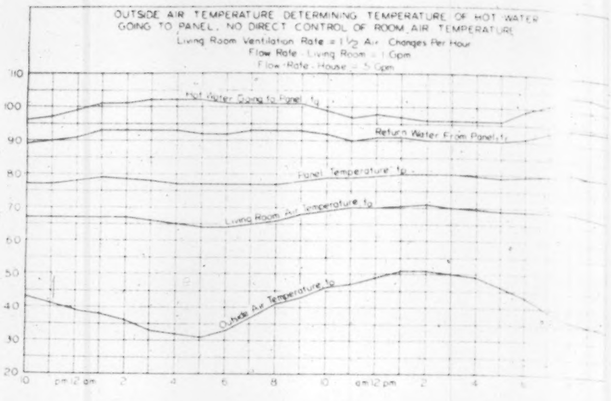

Fig. 11—Results from Test No. 4

with the insignificant lag of Test 1. The degree of overshoot is approximately the same for Tests 1 and 2. The maximum variation in panel surface temperature for any one cycle is 6 F and since the panel area is roughly ¼ of the total room surface, it follows that the probable order of magnitude of the corresponding change in mean radiant temperature is about 1½ F. The air temperature variation is about 1 F, but the minimums of air and panel surface occur simultaneously so the plus or minus departure of the equivalent comfort temperature (one-half the sum of air temperature and mean radiant temperature) is of the order of ¾ F. For the control system of Test 2 the heat was on for about ⅓ of the time in contrast to Test 1 (Fig. 8*a*) for which the *on* periods amounted to 1/10 or less of the total time; the average outside air temperature for both of these tests was approximately the same, 50 F.

Of interest in the analysis of Fig. 9 would be knowledge of the time interval between sequence operation of the four burners. The setting of the cams which determine burner operation has already been described, but no on-off time record was kept for each burner and the heating curves do not permit assured estimate of the number of burners on at a given time, or the intervals between their coming on. For future tests of the sequence control system with floor and wall panels a procedure has been developed for obtaining a record of the off-on time for each of the four burners.

Test No. 3: Modulating Thermostatic Control of Water Temperature at Discharge from Three-Way Mixing Valve. The performance of the heating system under this method of control shows marked advantage, see Fig. 10, over the methods of Tests 1 and 2. With this system the overheating of the water and the periodicity of the panel surface temperature are no longer evident. Panel temperature now varies as a smooth inverse function of load as represented by the outside air temperature and striking uniformity of inside air temperature was observed throughout the test. The 22 hr test period shown in Fig. 10 covers an outside temperature variation of 30 F, yet no deviation of inside air temperature from the control point occurred except during the last three hours of the test during which time the influence of solar radiation was sufficient to raise the room temperature even though the three-way valve was closed and no energy was being added to the house from the boiler. Note that in such circumstances overheating is not surprising since even though the heat supply is stopped the significant quantity of energy stored in the mass of the panel must continue to leave storage over a relatively long time period.

A greater number of tests of this type of control must be made before it will be possible to state whether or not the excellent performance shown in Fig. 10 is typical of what can be expected, but this one test and the few others which were made of the same system justify considerable optimism concerning the possibility of satisfactorily controlling a sinuous-coil plaster-embedded ceiling panel by means of a modulating thermostat and a three-way mixing valve.

Test No. 4: Outside Air Temperature Controlling Water Temperature at Discharge from Three-Way Mixing Valve. The results from this method of control, see Fig. 11, are unsatisfactory since a plus or minus 3½ deg departure from the control point occurred. As previously noted, however, part of this deviation must be attributed to the control equipment rather than to the control method since the desired linear relationship between outside air temperature and water temperature has not been realized. On the other hand the departure from this relationship which occurs during a long-time test is greater than that observable when the control equipment is separately checked for linearity hence there may be some influencing characteristic of the heating system that has not yet been recognized. By calculation from the data of Fig. 11 a correction to the observed inside air temperature can be made to take account of non-

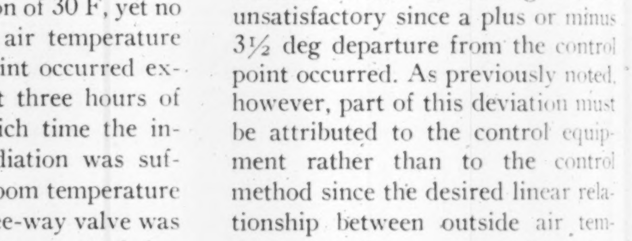

Fig. 12—Results from Test No. 5

linearity of the control relationship; when such a calculation is made the resultant corrected air temperature curve is much more satisfactory than the actual one; this seems to indicate that the test results of Fig. 11 do not do justice to this method of panel control. Further studies of this control system will be made and the results reported in a later paper.

Test No. 5: Outside Air Temperature Controlling Water Temperature with Partial Correction Available from Modulating Thermostat. Performance of this system is satisfactory (see Fig. 12) except during periods of sunshine simultaneous with moderate outside air temperatures; during such intervals the rise in room air temperature amounts to as much as 4 F. Part of the explanation of the solar rise probably is the reduced effectiveness of room air temperature change to vary the heat input required by changes in load other than that which is represented by the outside air temperature. Thus for the control system of Test No. 3 a sudden change in load occasioned by sunshine or by large change in occupancy can be reflected in a change of heat input over the range corresponding to zero to full design load. With the control system of Test 5, however, the room air temperature can exert a maximum influence on the heat input of only a fraction of the total range hence the system: (1) May be unable to handle large auxiliary load changes; (2) Will require more time, hence permit greater deviation, in restoring equilibrium conditions once a disturbance has occurred.

On the favorable side, the control system used in this test provides an anticipatory feature which may be of considerable value in buildings where either the structure or the panel is of high thermal capacity and low thermal diffusivity. This application of the system will be investigated in connection with tests, now scheduled, using the concrete floor panels in the Purdue test house.

Summary

This paper describes a panel heated test house which is in service on the Purdue University Research Housing Campus. The five-room residence is equipped with four independent sinuous-coil type hot-water panel systems located in the floor, ceiling, exterior walls, and interior partitions. Five different methods of controlling the panel heating are installed and have been tested. All tests reported in this paper are for ceiling panels *only* and were conducted with constancy of living room air temperature as a criterion of control; if optimum comfort had been the criterion, the inside air temperature would have had to be varied as an inverse function of load.

Test results show periodicity of panel surface temperature for both of the control methods which use off-on operation (or modulating sequence operation) of the burners as a means of regulating the energy input to the heating system. The period varies with load and with control method, but is of the order of two hours per cycle with a change in temperature of the surface (at constant impressed load on the structure) of approximately 6 F. When control methods are used which permit regulation of energy input by blending recirculated water with boiler water at fixed temperature, the periodicity no longer occurs and stable control is, in general, realized; of three systems of this type which were tested, best results were obtained from the one using a modulating room thermostat to fix the setting of a temperature sensitive element in the discharge line from the mixing valve; this element then controlled the position of the valve.

Further control tests will be made during the present heating season using the same five control methods, but applying them to floor, wall, and partition panel heating systems. Additional tests on the ceiling system will be run to provide data from a greater range of load conditions; results will be given in a research report which is planned for release in May, 1947.

Acknowledgment

Thanks are due to Messrs. W. P. Chapman and J. M. Ayres for the transposition of test data and the preparation of final curves; both men are graduate students and research fellows at Purdue University.

EDWIN TAZE MANUFACTURERS' REPRESENTATIVE

Edwin H. Taze, Baltimore, Md., has opened his own office under the firm name of Edwin H. Taze Co. at 11 East 21st St., as manufacturers' representative for air conditioning, dehumidifying, heating, ventilating and air cleaning equipment. Among the firms he represents are: Clarage Fan Co., Air-Maze Corp., C. A. Dunham Co., Propellair, Inc., and Multi-Vent Division of The Pyle National Co.

For the past seven years Mr. Taze was branch manager in Baltimore for the American Blower Corp. and prior to that he was in the sales engineering department of American Blower Corp., Detroit; Airtemp, Inc., Dayton, Ohio, and the National Gypsum Co., Buffalo, N. Y.

Mr. Taze received his B.S. in engineering at the University of Illinois in 1926. He joined the ASHVE in 1937.

TILLOTSON PROMOTED BY STURTEVANT

John J. Tillotson, a member of the ASHVE, has been appointed assistant manager of the service and construction department of B. F. Sturtevant Co., Division of Westinghouse Electric. A native of Minneapolis, Mr. Tillotson joined Westinghouse in 1938, shortly after his graduation from Antioch College with a bachelor of science degree in electrical engineering. After a year he left to become installation and service manager for the Westinghouse-franchised air conditioning contractor in the Pittsburgh area. He rejoined the company in May 1944 as air conditioning service engineer in Jersey City and moved to Hyde Park, Mass., in January 1946.

Another appointment announced recently at the B. F. Sturtevant Co., Division of Westinghouse Electric, at Hyde Park, is the appointment of Robert B. McLaughlin, tool room foreman since 1925, to the post of supervisor in charge of the safety, plant protection, first aid and volunteer fire department activities. A past chairman of the Industrial Division of the Massachusetts Safety Council, Mr. McLaughlin has been with Sturtevant since 1924.

E. O. EASTWOOD RETIRES FROM EXECUTIVE POSTS

After 41 years of instructing on the campus at the University of Washington, Seattle, Prof. E. O. Eastwood, former head of the aeronautical and mechanical engineering departments, has retired to half-time teaching. He is retiring principally from his administrative duties and will continue to instruct classes.

Professor Eastwood was honored recently with a surprise dinner given in his honor at the Faculty Club, where the faculty members of the two departments which he headed were hosts. The two groups presented him with a silver-plated flatware service for four. Professor Eastwood often invites friends to lunch with him at his office, where he keeps a hot plate and prides himself on his ability to cook.

Professor Eastwood served as president of the Society in 1942. He was born in Portsmouth, Va., and was graduated from the University of Virginia with a degree in civil engineering. He also received his A.B. and A.M. from the University of Virginia, and his B.S. from MIT.

Professor Eastwood is also a member of the *ASME* and is a member of the *American Society of University Professors.*

FISKE RESIGNS AS *ASRE* SECRETARY

The resignation of David L. Fiske, secretary of the *American Society of Refrigerating Engineers* since 1927, has been announced with regret by the officers of the Society.

Mr. Fiske's work for the Society included founding and editing the Refrigerating Data Book, established in 1932. During his term of 20 years the Society's membership increased from 600 to 4500 and the number of sections increased from 4 to 25.

Mr. Fiske graduated in mechanical engineering from the Massachusetts Institute of Technology in 1920, and received his master's degree in thermodynamics from the University of Illinois and a Ph.D. in industrial engineering, specializing in statistics, from Columbia University. His study *The Demand for Refrigeration* has become a common reference for information on the economics of this industry. He is also the author of tables of refrigerant properties and many writings on different phases of this field.

During the war Mr. Fiske was engaged in work connected with production control and later in the refrigeration division of the Quartermaster Corps with the rank of Major. In this capacity, he was sent on a mission to the Southwest Pacific last year and he has continued as a consultant to the War Department on refrigeration matters since he returned to civil life at the end of 1945.

Mr. Fiske plans to undertake consulting and other activities in the field of his specialty—market research in refrigeration.

C. E. SCOTT JOINS THE RITTLING CORP.

The appointment of C. E. Scott as vice president in charge of sales and advertising of The Rittling Corp., Buffalo, N. Y., has been announced by the president of the corporation, C. P. Rittling.

Mr. Scott, a graduate engineer of the University of Kentucky, where he specialized in thermodynamic research, has had many years of experience in the practical applications of heating, ventilating and air conditioning. He has a full understanding of the problems to be encountered in the coming era of radically new ideas in both industrial and domestic heating methods.

He was formerly affiliated with the York Heating and Ventilating Corp. where he organized the research laboratory and developed the basic factor method for rating unit coolers. He was also associated with Carrier Corp., and later served Warren Webster and Co., Camden, N. J., as sales supervisor for radiation, unit heater and air conditioning equipment.

C. E. Scott

In 1941 Mr. Scott joined The Fedders Mfg. Co., Buffalo, where he was in charge of the industrial heating division, and subsequently the refrigeration division. During the war he was a member of three industrial advisory committees.

Mr. Scott, a member of the ASHVE, is a past president of the *Industrial Unit Heater Association.*

DUDLEY PARKER ILLINOIS EASTERN REPRESENTATIVE

Dudley F. Parker is now eastern representative for the Illinois Engineering Co. of Chicago, with offices at 480 Broad St., Newark 2, N. J.

Mr. Parker has returned to civilian life after four years of active duty with the United States Navy, most of these years being spent in the Pacific Theater. Before joining the Navy he was associated with the Nash Engineering Co. as sales engineer in the metropolitan New York area, and prior to that he was eastern manager of the National Regulator Co.

Mr. Parker was graduated from Sheffield Scientific School at Yale University, New Haven, Conn., where he specialized in mechanical engineering.

DR. VANNEVAR BUSH RECEIVES HOOVER MEDAL

Dr. Vannevar Bush, president, Carnegie Institution of Washington, and wartime director of the Office of Scientific Research and Development, has been named 1946 winner of the Hoover Medal, jointly awarded by four national engineering societies, the *American Institute of Electrical Engineers*, the *American Society of Civil Engineers*, the *American Institute of Mining and Metallurgical Engineers*, and the *American Society of Mechanical Engineers.*

The medal was formally conferred on Dr. Bush on January 30, at the Engineering Societies Building, New York, N. Y., during the winter meeting of the *AIEE*. The citation reads as follows:

> **Engineer, educator, and administrator, who, in critical time of need, was**

in a most special sense an organizer, guiding spirit, and driving force of the nation's achievements in physical and medical science; to whom, for outstanding public service, is awarded the Hoover Medal for 1946.

The Hoover Medal is deemed one of the outstanding honors of the engineering profession and is given "to honor engineers whose preeminent services have advanced the well-being of mankind and whose talents have been devoted to the development of a richer and more enduring civilization."

Dr. Bush, a graduate in electrical engineering from Tufts College, holds honorary degrees from Tufts, MIT, Harvard, Brown, Middlebury College, Johns Hopkins, University of Pennsylvania, Yale, Polytechnic Institute of Brooklyn, Rutgers, Williams, and Stevens Institute of Technology. He is the author of many technical works, and is the inventor of a differential analyzer, a machine for solving differential equations.

ARMY HONORS C. J. MERRITT

Cecil J. Merritt, superintendent of the Shanghai American School, Shanghai, China, served for ten months as senior civilian engineer with the U. S. Army, Corps of Engineers. Immediately after the conclusion of hostilities, in appreciation of his services the Meritorious Civilian Ribbon was awarded him with the following citation:

> Mr. C. J. Merritt is awarded the Emblem for Civilian Service for meritorious service and devotion to duty during the period 15 November 1945 to 15 January 1946. During this period, Mr. Merritt worked long hours each day, seven days each week, without benefit of time off, or additional remuneration, to alleviate the then critical problem of furnishing adequate heat for United States Forces. Through his cheerful application of the vast technical knowledge that he possesses and his innumerable contacts and business associations, the work on these vital projects was expedited. The comfort and welfare of the United States Forces was always of paramount importance with Mr. Merritt. The cheerful attitude and cooperation shown by Mr. Merritt was exemplary, and his associates within his section and in other sections requiring contact and cooperation always enjoyed working with him. During the early days of the United States Forces' tenancy in Shanghai, the constantly changing accommodations and lack of necessary materials for heating installations required improvisation and flexible design of heating installations to permit expansion, Mr. Merritt at all times gave freely of his time and knowledge to accomplish the work required.

PERFEX ANNOUNCES NEW OFFICERS

The Perfex Corp., Milwaukee, announces the election of Carroll E. Lewis as president and director, and Julius K. Luthe to the position of chairman of the Board at the December meeting of the Board of Directors. Mr. Lewis, a graduate of the University of Minnesota, was elected to the post of executive vice president in September 1946, responsible for all general operations of the company. He joined Perfex in 1944. Mr. Luthe was formerly president of Time-O-Stat Controls Co., Elkhart, Ind. He founded the present Perfex Corp. in 1934 and has been its president since that year.

It was also announced that Allen Butler, vice president, has taken over the responsibilities formerly handled by Mr. Lewis in the Controls Division. Mr. Butler joined Perfex in 1935 and was manager of the Chicago Branch, and in December 1945 he was named a vice president.

W. V. KINCAID IN NEW POST

Announcement has been made of the appointment of Wendell V. Kincaid as sales representative in the Tennessee Valley with headquarters in Knoxville, Tenn., for the Pittsburgh Lectrodryer Corp.

A graduate of Vanderbilt University with a bachelor's degree in chemical engineering, Mr. Kincaid became associated with Lectrodryer in 1942 and has served in the firm's Chicago office and in the Pittsburgh plant as both a sales and service engineer. At the Pittsburgh plant he was engaged in the development of the dehumidifying machines used by the Navy in its fleet preservation program.

Prior to Mr. Kincaid's association with Lectrodryer he worked in the research and development departments of Alladin Industries, Inc., and the Cardox Corp.

Besides being an associate member of the ASHVE, Mr. Kincaid is also a member of the *American Society for Metals*, and is a registered professional engineer.

NEW RADIANT HEATING EQUIPMENT FIRM ANNOUNCED

Announcement has been made of the formation of Pan-L-Heat Corp., P. O. Box 4090, Portland 8, Ore., by its general sales manager, W. R. Norte, formerly with Crane Co. The new corporation has been formed by Mr. Norte, P. F. Sandsted and Marie E. Vengelen, all of Portland. The corporation will manufacture a fabricated pipe grid unit for application to warm water radiant panel heating systems. This grid unit will be equally applicable to ceiling, wall or floor panel installations in residential, commercial, industrial and public buildings. A research and development department has been established at their plant and plans have been made for future development of all equipment used in panel heating systems.

Mr. Norte has been with Crane Co. for the past nine years and Mr. Sandsted and Miss Vengelen had been partners for more than ten years in the Plumbing & Heating Engineering Co. of Portland.

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G. E. ANNOUNCES DEATH OF W. C. DETERLING

Word has been received from General Electric Co. New York office of the death on September 27, 1946, of William C. Deterling, section head of their Industrial Department. Mr. Deterling had been ill with a heart condition for some months and died suddenly when he was planning to return to the office.

Mr. Deterling was born in Brooklyn, N. Y., on November 22, 1891, and attended Pratt Institute at night, where he specialized in electrical engineering.

He joined the staff of General Electric in April 1919, starting as a junior clerk. In 1913-1914 he took the G. E. test course at the Schenectady office and had been located in the New York office since that time.

He joined the Society in 1936 and was a member of the New York Chapter.

Mr. Deterling is survived by his widow and family to whom the Officers and Council of the American Society of Heating and Ventilating Engineers extend their sincere sympathy.

LIFE MEMBER E. J. FEBREY DIES IN WASHINGTON

E. J. Febrey

Word has been received by the Society of the death of Ernest J. Febrey, Life Member, on November 27, 1946, at Washington, D. C. Mr. Febrey was born on July 26, 1867, at Falls Church, Va.

He started to work in the heating field about 1890 and in 1895 went into business for himself in Washington, D. C., under the name of E. J. Febrey & Co., heating contractors and heating and ventilating engineers. He was sole proprietor until 1938 when he incorporated the business under the same firm name, taking two of his associates into the business. He served as president of the company until about two months before his death.

Mr. Febrey took great pride in stating that his company was one of the oldest heating and ventilating concerns in the Nation's Capital and the only one still operating under the original name.

He installed the heating plants in many notable buildings in Washington, such as the old Southern Railway building, the MacLachlan Bank, the Second National Bank, the Continental Hotel, the Y.W.C.A. and many apartments and some of the finest homes in the city. One of his most interesting jobs was the installation of the steam heating plant in the Lee Mansion in Arlington National Cemetery.

He joined the Society in 1903 and took an active interest in all its activities. He was instrumental in organizing the Washington, D. C. Chapter, of which he was a charter member. He was appointed general chairman of the committee on arrangements for the 1922 Annual Meeting held in Washington, D. C., and was elected to Life Membership in the Society in 19[illegible]7. He was always an active member of the Society and could be depended upon for advice or assistance whenever needed, and will be greatly missed by his many friends and associates in the Washington, D. C., Chapter.

Mr. Febrey was also a member of the *Heating, Piping and Air Conditioning Contractors National Association*, the Washington Board of Trade and served for many years on its Law and Order Committee. He was a member of the Foundry Methodist Church for many years and later became affiliated with the Wesley Memorial Church, and was active in all its affairs. He was also a member of the Masonic Order.

Mr. Febrey was seriously injured in an automobile accident in 194[illegible] and recovered only after a long illness. He never fully got over this accident but was fairly active until 1944.

He is survived by his widow, two brothers, two sisters and a stepdaughter, to whom the Officers and Council of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS extend their sincerest sympathy.

SUMMARY OF LOCAL CHAPTER MEETINGS*

ATLANTA—January 3, 1947. Subject: Smoke Abatement. Speaker: Prof. R. S. King, Georgia School of Technology, and member of the City Smoke Abatement Bureau. Professor King told what the Smoke Abatement Bureau has done and what it hopes to do in the future. An interesting discussion followed. Other Features: G. R. Bilderback reported on the Chapter's finances and W. W. Carder reported on the future programs for the Chapter meetings. Attendance 32. Attendance ratio 0.33.

ATLANTA—December 6, 1946. Subject: Textile Mill Air Conditioning. Speaker: P. L. Davidson, consulting engineer, Greenville, S. C., and Philadelphia, Pa. Mr. Davidson's conclusions were, taking into consideration initial cost, operating costs, and performance, that textile mill air conditioning jobs should be of either the unit or central station type with supplementary evaporation and refrigeration. A question and answer period followed. Other Features: Pres. H. King McCain presided and announced the election of officers as nominated previously. H. W. Reil reported for the program committee and P. E. Seepe reported on the membership. President McCain appointed a committee composed of M. M. Crout, chairman, W. W. Carder and L. L. Barnes to meet with the *ASME* to select a mechanical engineer to act on the City Council's Advisory Board on City Codes. A motion was made and passed that the newly elected president be sent to the Annual Meeting in Cleveland as delegate. Attendance 53. Attendance ratio 0.55.

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CENTRAL OHIO—December 16, 1946. Subject: Utilization and Testing of Gas Appliances. Speaker: R. M. Conner, director, *American Gas Association* Testing

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*Note. The attendance ratios shown represent the membership attendance divided by the chapter membership. These ratios will be useful as a partial indication of interest shown by local chapter members in various types of subjects programmed by the various chapters and may be useful in deciding on subjects for chapter meetings.

Laboratories, Cleveland, Ohio. He explained how the various approval and testing requirements are set up for each type of appliance, and committees are appointed by the *AGA* consisting of equal members of gas company and manufacturer representatives who are thoroughly familiar with the particular appliance covered. He further explained that requirements are periodically revised to keep them in step with the progress in research and development. He also pointed out that in the case of conversion burners, there were not only listing requirements but also installation requirements. He stressed the importance of proper installation to insure efficient, trouble free, and safe operation. There was a lively discussion following Mr. Conner's talk. Other Features: R. B. Breneman was elected as Chapter Delegate and H. R. Allonier as Alternate. Attendance 47. Attendance ratio 0.47.

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CINCINNATI—December 3, 1946. Subject: German Refrigeration Industry at War. Speaker: E. T. Simonson, Hughes-Simonson Engineering Co., Dayton, Ohio. Mr. Simonson's talk was well received by the members of the Cincinnati Chapter, many of whom have asked him to repeat it at some later date. The information given in Mr. Simonson's talk, which he had gathered at first hand in Germany, had just been released by the War Department. Other Features: Letters were read regarding the raising of funds for reducing the mortgage on the Society's Research Laboratory, Cleveland. Following reports of the various committee chairmen, a nominating committee was elected consisting of five Chapter past presidents and E. J. Richard acting as chairman. Attendance 44.

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DELTA—December 10, 1946. Subject: Low Temperature Freezing. Speaker: Louis Netteship, Frick Co. An interesting discussion followed. Other Features: G. E. May reported that progress was slow on the project, Air Conditioning in Schools. L. V. Busenlener reported on the finances of the Delta Chapter. The matter of contributing to help pay off the mortgage on the Society's Research Laboratory was discussed. A nominating committee was elected as follows: C. B. Gamble, L. V. Cressy, G. C. Kerr, W. H. Grant, Jr., and G. E. May. Attendance 24.

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GOLDEN GATE—December 5, 1946. Subject: Panel Heating and Its Control. Speaker: Ferdinand Jehle, director of engineering, Hoffman Specialty Co., Indianapolis, Ind. Mr. Jehle discussed various problems in the design of panel heating installations and their controls. His talk was well received, as evidenced by the great number of questions from the floor. Other Features: Pres. James Gayner introduced Daniel Hayes, president of the *Heating, Piping and Air Conditioning Contractors Association* of Northern California. Attendance 123. Attendance ratio 0.32.

ILLINOIS—December 9, 1946. Subject: Control of Panel Heating. Speaker: John E. Haines, president of the Minnesota Chapter and vice president, Minneapolis-Honeywell Regulator Co., Minneapolis, Minn. Mr. Haines illustrated his talk with slides picturing the fundamentals of radiant heating and showing typical control hook-ups. J. J. Floreth of the Chapter meetings committee, conducted an interesting question and answer period. Other Features: Cyril Tasker, director of research, and Clyde A. McKeeman, assistant to the president of the ASHVE, were guests at the meeting, and each spoke briefly on Society research. James S. Locke, past president of the Chapter, who now resides in Minneapolis, was also a welcome guest. Prior to Mr. Haines' talk E. B. Ericsson reported on activities of the Chicago Technical Societies Council, and M. J. Bamond introduced the newly elected members of the Chapter. Attendance 152.

ILLINOIS—November 11, 1946. Subject: Panel Discussion on Insulation. Speakers: M. B. Burleson, Johns-Manville, spoke on the insulation of piping; Edward DeCamp, Philip Carey Mfg. Co., spoke on the insulation of tanks, heat exchangers, and ducts; E. C. O'Connor, Asbestos and Materials Mfg. Co., discussed the practical problems from the installer's viewpoint. Pres. Oliver J. Prentice presided at the Panel and R. S. Ash introduced the speakers and conducted the question and answer period. Attendance 95. Attendance ratio 0.50.

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MANITOBA—November 21, 1946. Three entertaining motion pictures were shown.

MANITOBA—October 21, 1946. Subject: The Post War Era—A Challenge to Heating and Air Conditioning Engineers. Speaker: Alfred J. Offner, president of the ASHVE, and consulting engineer, New York, N. Y. A vote of thanks was extended to Mr. Offner for his interesting talk. Attendance 35.

MANITOBA—September 26, 1946. Informal Discussion. Pres. R. E. Moore presided. Attendance 15.

MANITOBA—May 16, 1946. On motion of J. B. Steele, seconded by D. F. Michie, the slate of officers as presented by the nominating committee was unanimously elected as follows: President—R. E. Moore; Vice President—D. S. Swain; Secretary-Treasurer—J. R. Stephenson.

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MASSACHUSETTS—December 17, 1946. Subject: The Post War Era—A Challenge to the Air Conditioning Engineer. Speaker: Alfred J. Offner, president of the ASHVE and consulting engineer, New York, N. Y. Following his talk, Mr. Offner told of the plan of the Ontario and Northern Ohio Chapters for raising a fund to pay off the mortgage on the new Research Laboratory Building, Cleveland. It was voted to contribute the four $100, series F, U. S. Government Bonds, from the Chapter's treasury, to help reduce the mortgage. Attendance 25. Attendance ratio 0.33.

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MEMPHIS—December 16, 1946. Subject: Heat Pump. Speaker: Carl F. Boester, Housing Research Executive,

Purdue Research Foundation, Purdue University, Lafayette, Ind. Pres. R. H. Hoshall thanked Mr. Boester, on behalf of the Chapter, for his excellent presentation. Other Features: N. C. Ledbetter was named delegate and J. B. Lammons as alternate to the Annual Meeting in Cleveland. W. L. Henson submitted the treasurer's report. President Hoshall read a letter from the secretary of the Society regarding the plan to liquidate the mortgage on the Society's Research Laboratory. Attendance 41.

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MICHIGAN—December 16, 1946. Subject: Design and Application of Unit Heaters—Testing and Rating, Corrosion Problems, Relation to Radiant Heating. Speaker: A. G. Dixon, secretary, Modine Mfg. Co., Racine, Wis. Mr. Dixon's talk, beginning with the evolution of the unit heater and followed by suggestions for application of the various types, illustrated by slides, was interesting and instructive. A rising vote of thanks was extended to Mr. Dixon. Other Features: G. D. Winans reported on the Refresher Course being started by the *Engineering Society of Detroit* for engineers desiring to take the State examination for registration. Pres. F. R. Bishop told of the plan of the Ontario and Northern Ohio Chapters to raise funds to help pay off the mortgage on the Society's Research Laboratory, Cleveland. A motion was made and carried that the treasurer send a check for $200 as a contribution from the Michigan Chapter. Attendance 66. Attendance ratio 0.43.

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MINNESOTA—January 6, 1947. Subject: Baseboard Heating. Speaker: Prof. W. S. Harris, assistant professor of special research, University of Illinois, Urbana, Ill. Professor Harris showed slides to compare the results obtained with conventional cast iron radiators and two different types of baseboard heating in the research residence at Urbana. He answered many questions during the discussion that followed. Other Features: Pres. J. E. Haines made an announcement on the campaign being conducted to liquidate the mortgage on the Research Laboratory, Cleveland. Chester Lawrence was appointed to act as chairman of a committee to poll the Chapter members for contributions for this purpose. Bruce McLouth reported on the membership plans. Attendance 117. Attendance ratio 0.67.

MINNESOTA—December 2, 1946. Subject: Diagnosing and Correcting Corrosion Troubles in Steam Heating Systems. Speaker: Leo F. Collins, consulting engineer, Detroit Edison Co., Detroit, Mich. Mr. Collins gave an interesting talk, which he illustrated with slides. In the course of discussion he answered many questions. Other Features: President Haines was elected as delegate and A. B. Algren as alternate to the Annual Meeting in Cleveland. Bob Mahon, Swiss yodler and accordion player, was introduced. He gave several selections and performed a number of stunts, all of which were thoroughly enjoyed as evidenced by the applause. Attendance 92. Attendance ratio 0.56.

NEBRASKA—December 10, 1946. Subject: Operation of the Omaha Alcohol Plant. Speaker: Dr. G. M. Severson, technical director, Farm Crops Processing Corp. The speaker explained the process of making alcohol from corn and told of the difference in processing necessary to produce alcohol from potatoes. Dr. Severson gave the impression that making alcohol today was only a transition period of making alcohol until grain again became a surplus. Attendance 27.

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NEW YORK—November 18, 1946. Subject: Society Research—Present Program and Future Possibilities. Speaker: Cyril Tasker, director of research of ASHVE, Cleveland, Ohio. Pres. Alfred J. Offner introduced Mr. Tasker, who replied to questions on Society's research. A rising vote of thanks was given to Mr. Tasker. Other Features: Chapter President Sherbrooke introduced M. J. Gartside, England, a guest of the New York Chapter, who made a few comparisons between American and British methods of heating. He closed his remarks with the statement that he was impressed by the great prevalence of automatic controls in heating installations in the United States. W. H. Driscoll, past president of the ASHVE, was welcomed at the meeting, and President Sherbrooke referred to the great value of Mr. Driscoll's activities in promoting the Society's Research Laboratory and establishing it on a firm foundation. Attendance 60. Attendance ratio 0.23.

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NORTH TEXAS—December 16, 1946. Annual Christmas party was held at the Hi-Hat Club, Northwest Highway. Following dinner Pres. E. J. Stern announced that the nominations submitted for the 1947 officers were elected as follows: President—C. R. Gardner; Vice President—B. S. Foss, Jr.; Secretary-Treasurer—G. A. Linskie; Board of Governors—M. L. Brown, L. S. Gilbert and E. J. Stern. C. R. Gardner, in charge of arrangements to bring the Texas group to the Cleveland Annual Meeting, reported that the car was sold out. The meeting was then turned over to Mr. Linskie, chairman of the program committee, who arranged a technical and educational program for the balance of the evening. Attendance 86.

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NORTHERN OHIO—December 9, 1946. Subject: Latest Developments in Dust Control for Industry. Speaker: M. I. Dorfan, manager, Dust and Fume Engrg. Div., American Foundry Equipment Co., Mishawaka, Ind. A lively discussion followed. Other Features: Graves Taylor gave a short talk covering the various phases of advertising and publicity in connection with the Society's Annual Meeting in Cleveland. John James reported that the new roster had been sent to all members and reviewed the current activities of the Technical Societies Council. Mr. James and W. R. Moore were elected as delegate and alternate to the Annual Meeting. Attendance 50. Attendance ratio 0.34.

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ONTARIO—January 6, 1947. Subject: Odors, Their Nature, Cause and Control. Speaker: Henry Sleik chief engineer, W. B. Connor Engineering Corp., New York, N. Y. Other Features: H. D. Henion reported that he had collected $304 from 32 members for contribution to the fund to liquidate the mortgage on the Society's Research Laboratory. Attendance 86. Attendance ratio 0.30.

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OREGON—December 5, 1946. Subject: Operations of a District Steam Plant. Speaker: Day Ward, superintendent, Steam Dept., Northwestern Electric Co. Other Features: R. C. Chewning submitted the treasurer's report. T. H. McClung reported as chairman of the membership committee. Pres. W. Bruce Morrison and J. Donald Kroeker were elected as delegate and alternate to the Annual Meeting in Cleveland. A discussion followed on the plan to reduce the mortgage on the Society's Research Laboratory, Cleveland. Attendance 52.

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PHILADELPHIA—December 12, 1946. Subject: Technique of Dust Counts and Their Interpretation. Speaker: K. R. Doremus, Pennsylvania Dept. of Health, Dept. of Industrial Hygiene. Attendance 83. Attendance ratio 0.7.

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PITTSBURGH—December 9, 1946. Subject: Control of Air-Borne Infection by Sanitary Ventilation. Speaker: Dr. W. F. Wells, director, Laboratory for Study of Air-Borne Infection, School of Medicine, University of Pennsylvania, Philadelphia, Pa. Dr. Wells spoke first of the means of controlling contagious diseases in the years gone by and what is being done for the present students with ultra violet radiation. He then gave a comparison of two schools in the East, one using the lamps and the other without them, and showed slides with the results of the tests conducted. Attendance 41. Attendance ratio 0.46.

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ST. LOUIS—December 3, 1946. Subject: After World War II, What? New Developments in Aerodynamic Research and Their Possible Applications in Time of War. Speaker: L. J. Sverdrup, Sverdrup and Parcel, who was General in charge of all engineering in the Pacific Theater during the latter part of the recent war under General MacArthur. General Sverdrup revealed some startling facts with which he was familiar. He told of the wind tunnels for experiments in the controlled flight of rockets and other objects capable of testing these flights under conditions of speeds up to 7500 mph which were found in Germany when the Army of Occupation took over. He stated that the research work being done by the Germans was unquestionably far superior to that by any other country. Attendance 49.

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SOUTH TEXAS—December 16, 1946. Annual Christmas party. Pres. B. P. Fisher commented upon the fine work of the arrangements committee consisting of C. C. Quin, A. J. Natkin and F. C. Brandt. Wayne Long introduced the guests from A. and M. College and told of the activities of the A. and M. Student Branch, which now numbers 63 in the group. C. L. Boehler gave a short talk on membership. President Fisher presented each member with a new Roster as a Christmas remembrance, which was greatly appreciated by the members. The Christmas program was enjoyed by all. Attendance 79.

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SOUTHERN CALIFORNIA—December 11, 1946. Subject: Panel Heating. Speaker: Ferdinand Jehle, director of engineering, Hoffman Specialty Co. He pointed out that panel heating affords both radiant and convection heating, and calculating the size of panel and heat losses of buildings is to be figured the same as for any other heating system. Mr. Jehle gave an example of calculating an installation and discussed different types of coil design and control, using slides to illustrate. Other Features: Pres. Art Theobald made a report on the plan for reducing the mortgage of the Research Laboratory and appointed a committee to accept contributions from local Chapter members toward helping pay off this mortgage. The committee consists of J. S. Earhart, chairman; A. B. Banowsky, M. C. Greiner, A. G. Orear and R. F. Lauer. Attendance 110

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WASHINGTON, D. C.—December 11, 1946. Subject: Condensation in Buildings. Speaker: R. S. Dill, chief, Heat Transfer Section, National Bureau of Standards, Washington, D. C. After an interesting discussion Vice Pres. H. H. Hill announced the death of E. J. Febrey, a charter member of the Chapter and Life Member of the Society. Attendance 74. Attendance ratio 0.46.

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WESTERN MICHIGAN—December 8, 1946. Subject: Air Diffusers. Speaker: M. J. Stevenson, chief consulting engineer, The Pyle National Co., Chicago, Ill. He gave a short history of the different types of registers, including the plaque and perforated plaque and the ceiling diffuser. Other Features: After the reading of the treasurer's report a letter was read from the Northern Ohio Chapter regarding the raising of funds to pay off the mortgage on the Research Laboratory and it was voted that $100 be given by the Chapter for this purpose. Attendance 68. Attendance ratio 0.1.

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WISCONSIN—December 16, 1946. Subject: Weather, Climate and Industry. Speaker: J. C. Spangler, meteorological instrument engineer, Johnson Service Co., Milwaukee, Wis. Mr. Spangler traced recent developments in the field of meteorology and weather forecasting, indicating the accelerated progress in this work both in the training of personnel and development of new instruments. He pointed out that this rapid progress, as in many other fields, resulted from the urgent need for this information by our armed forces. The technique developed under the war-time advances is now being used to obtain more accurate climate and meteorological data for peace time use in industrial, housing, medical, aeronautical and even recreational fields. He indicated still further need for more of this information, particularly that pertaining to solar radiation. Other Features: Carl Amundson reported for the membership committee and E. J. Gerstenberger announced the plans for future meetings. Attendance 42.

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TEXAS A. & M. STUDENT BRANCH HOLDS MEETING

A meeting of the Texas A. & M. Student Branch of the ASHVE was held on January 9, 1947, and was called to order by Pres. K. W. Ryan. The minutes of the previous meeting were read and approved and the president announced that the Student Branch charter has been approved and would be officially presented at a later date. Congratulatory messages from many of the local chapters were read.

Tentative plans for an exhibit to be sponsored by the Student Branch for *Engineers' Day* to be held on the Campus on May 10th were announced. Wayne Long, professor of mechanical engineering at the College, announced that Richard C. Jordan, assistant head, Dept. of Mechanical Engrg., University of Minnesota, was to address the refrigeration class on January 10th, and urged the student members to attend.

The members of the South Texas Chapter were present and the subjects discussed were as follows: Compressors discussed by A. M. Chase and H. W. Broadwell; Controls by F. C. Brandt; Steam and Hot Water Heating by A. F. Barnes; Specifications and Materials Selection by R. J. Salinger; Air Distribution by D. S. Cooper; and Direct Fired Gas Heating by B. P. Fisher.

CANDIDATES FOR MEMBERSHIP

The Constitution of the Society, as now amended, requires the following mode of procedure in voting on applicants for membership in the Society. All applications for membership are to be sent to the Secretary and the names of applicants and their references shall be printed in the next issue of the JOURNAL of the Society or sent to the members in other approved manner as ordered by the Council. When the replies are received from references, the Candidate's application shall be submitted to and acted upon by the Committee on Admission and Advancement as soon as possible.

When the Committee on Admission and Advancement has acted favorably upon a Candidate's application and assigned his grade, the Council shall vote upon the election of the proposed Candidate for membership by letter ballot. During the past month 107 applications for membership have been received and the names of these men and their sponsors are published in the following list.

Members are requested to scrutinize the list with care. The Committee on Admission and Advancement, and in turn, the Council, urge members to assume their share of responsibility of receiving these candidates into membership by advising the Secretary promptly of any whose eligibility for membership is in any way questioned.

All correspondence in regard to such matters is strictly confidential, and is solely for the good of the Society, which it is the duty of every member to promote.

Unless objection is made by some member by February 25, 1947, these candidates will be balloted upon by the Council. Those elected to membership will be notified by the Secretary immediately after election.

ACHEY, HARRY S., Draftsman C. E. Mills. PROPOSERS: C. T. Baker*, J. H. Hardy*. SECONDERS: K. A. Jones*, R. N. Dulaney*.

ALLEN, RAYNOLD W., Mgr., Htg. Dept., Atlas Supply Co. PROPOSERS: C. Z. Adams, C. E. McCallum. SECONDERS: P. L. Guest, Jr., Arvin Page.

ALLEN, ROBERT C., JR., Branch Mgr., General Controls Co. PROPOSERS: C. D. Jones, C. V. Werner. SECONDERS: C. L. McMichael, P. C. Leffel.

ALLEN, S. RUSHMORE, Field Engr., American Blower Corp. PROPOSERS: H. H. Hill, L. T. Davis. SECONDERS: R. F. Dovener, F. A. Leser.

ARMSTRONG, ROY E., Bldg. Chief Engr., Humble Oil & Refrigerating Co. PROPOSERS: C. C. Quin, R. F. Taylor. SECONDERS: R. J. Salinger, H. L. DeVine.

ATTEBERRY, CLARK, Owner, Atteberry's Heating & Sheet Metal Works. PROPOSERS: M. W. Brown, J. A. Bishop. SECONDERS: B. P. Fisher, R. L. Stanley.

AUERBACH, LEONARD F., Sales Engr., The Spohn Heating & Ventilating Co. PROPOSERS: G. P. Nachman, J. L. Frisse. SECONDERS: L. C. Burkes, R. E. Sherman.

BAKSA, STEPHEN, Utility Engr., Johnson & Johnson. PROPOSERS: D. R. Knapp*, J. J. Eberl*. SECONDERS: M. E. Foster*, M. H. Bilyk*.

BALSTER, JOSEPH A., Chief Engr., Cafritz Co. PROPOSERS: C. R. Kidd, R. P. Gaulin. SECONDERS: R. Skagerberg, J. N. Stewart.

BECRAFT, E. R., Dept. Mgr., The Trane Co. PROPOSERS: K. O. Alexander, R. H. Anderegg. SECONDERS: L. W. Hessler, S. G. Swisher, Jr.

BENN, CHARLES L., Htg. Engr., Equitable Gas Co. PROPOSERS: L. S. Maehling, O. L. Williams. SECONDERS: G. S. Peacock, E. C. Smyers.

BLATHERWICK, HOWARD E., Warden King, Ltd. PROPOSERS: J. B. Flanagan, E. J. Lefebrve. SECONDERS: George Ballantyne, J. B. Way.

BOHREN, ARTHUR H., Owner, Bohren Plumbing Service & Supply Co. PROPOSERS: E. R. Lokey, W. R. Norte. SECONDERS: J. H. Bonebrake, T. H. McClung.

BREYER, WILLIAM L., Draftsman, E. A. Cornely, Inc. PROPOSERS: B. F. Raber, F. W. Hutchinson. SECONDERS: E. A. Cornely, George Sweeney.

BROWN, JACK W., Student, Texas A. & M. College. PROPOSERS: W. E. Long, J. S. Hopper. SECONDERS: Carl Files, C. W. Crawford.

CALLINS, JACK G., Student, Texas A. & M. College. PROPOSERS: W. E. Long, J. S. Hopper. SECONDERS: Carl Files, C. W. Crawford.

CASTROW, OTTO E., Estimator, Asbestos Supply Co. PROPOSERS: J. D. Kroeker, R. C. Chewning. SECONDERS: J. H. Bonebrake, T. H. McClung.

CHAPMAN, WILLIAM P., Research Fellow, Purdue University. PROPOSERS: C. F. Boester, F. W. Hutchinson. SECONDERS: W. T. Miller, D. A. Evans.

COOK, ROBERT L., Student, Texas A. & M. College. PROPOSERS: W. E. Long, J. S. Hopper. SECONDERS: Carl Files, C. W. Crawford.

COOPER, JOHN A., Sales Engr., W. F. Slater Engineering Corp. PROPOSERS: A. T. Bevil, E. E. Scott. SECONDERS: J. B. Lammons, R. H. Hoshall.

COUSART, KIRKPATRICK, Mfrs. Repr., Lydon-Cousart Co. PROPOSERS: Karl Selden, Jr., E. S. deWitt. SECONDERS: E. H. Brandt, Jr., Arvin Page.

DESMOND, OWEN, Sales Mgr., Modine Manufacturing Co. PROPOSERS: A. G. Dixon, Benjamin Spieth. SECONDERS: H. A. Pillen, W. N. Donelson.

DEVLIN, JAMES J., Partner, W. C. Devlin & Sons. PROPOSERS: Jacob Schwartz, Albert Mol*. SECONDERS: C. T. Best, R. L. Stinard.

DEYO, CLYDE D., JR., Asst. Chief Power Plant Engr., General Motors Corp. PROPOSERS: M. J. Bamond, V. L. Wesby. SECONDERS: J. J. Philippi, A. H. Blake.

DUITCH, PAUL R., Mech. Engr., Iowa Sheet Metal Contractors, Inc. PROPOSERS: C. A Wheeler, M. M. Tappen. SECONDERS: D. C. Murphy, F. E. Triggs.

DUKE, RAYMOND Q., Design Engr., The Detroit Edison Co. PROPOSERS: J. N. Livermore, J. H. Walker. SECONDERS: E. E. Dubry, G. D. Winans.

EASTIN, MAURICE R., Eastern Zone Mgr., Minneapolis-Honeywell Regulator Co. PROPOSERS: L. B. Belford, J. R. Bergan. SECONDERS: O. F. Quist, Jr., J. H. Broome.

EBERHART, JOSEPH F., Engr., Kerby Saunders, Inc., PROPOSERS: I. B. Kagey, E. R. Foss. SECONDERS: W. M. Garrard, Leo Sudderth, Jr.

EDWARDS, IRVIN G., Sales Engr., The Trane Co. PROPOSERS: A. W. Edwards., J. J. Bechtol. SECONDERS: H. A. Pillen, J. D. Jones.

ELBOGEN, NICHOLAS, Engr., B.T.U. Heating & Cooling. PROPOSERS: A. B. Banowsky, J. S. Earhart. SECONDERS: Leo Hungerford, R. A. Lowe.

ELLIOTT, CHARLES L., Supvsr., Htg. Engrg. Div., Cincinnati Gas & Electric Co. PROPOSERS: A. W. Edwards, G. V. Sutfin. SECONDERS: Vincent Hotze, K. B. Little.

EVANS, WILLIAM W., Sales Engr., The Trane Co. PROPOSERS: L. E. Slawson, W. H. Silk. SECONDERS: C. F. Eveleth, E. E. Maurer.

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HUMBLE, JOHN D., Student, Texas A. & M. College. PROPOSERS: W. E. Long, J. S. Hopper. SECONDERS: Carl Files, C. W. Crawford.

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JAHN, RUDOLPH, JR., Student, Texas A. & M. College. PROPOSERS: W. E. Long, J. S. Hopper. SECONDERS: Carl Files, C. W. Crawford.

JANDER, YORKE G., Pres., Admiral Air Conditioning Corp. PROPOSERS: C. S. Koehler, O. F. Quist, Jr. SECONDERS: B. B. Howes, J. R. Duncan*.

JONES, FRANK, Products, Inc. PROPOSERS: D. E. Wells, R. H. Schnell. SECONDERS: E. H. Borg, C. A. Wheeler.

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MASON, ROBERT E., Engr., Sidles Co. PROPOSERS: F. E. Prawl, Verne Simmonds. SECONDERS: O. J. Smith, B. G. Peterson.

MAYO, WILLIAM, P. JR., Engr., Royal Air Conditioning Co. PROPOSERS: R. F. Taylor, R. J. Salinger. SECONDERS: A. M. Chase, Jr., C. C. Quin.

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MCGHAN, FRED W., Mech. Engr., National Housing Agency. PROPOSERS: L. Sherman, C. B. Droba. SECONDERS: C. W. Porter, J. D. Brooks.

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MOESEL, FRED L., Owner, Fred L. Moesel Assoc. PROPOSERS: A. J. Offner, S. A. S. Patorno. SECONDERS: Edwin Sternberg, R. H. Carpenter.

MONTAGUE, FREDERICK H., Mech. Engr., Walter Scholer & Associates. PROPOSERS: G. B. Supple, A. L. Henze. SECONDERS: Walter Scholer*, Ernst Schaible, Jr.*

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Soronen, Robert C., Htg. & Vent. Engr., D. J. Murray Manufacturing Co. Proposers: Einar Koskinen*, H. J. Eklund*. Seconders: S. D. Payzer*, N. A. Gray*.

Sprague, George W., Mgr., Moduflow Dept., Minneapolis-Honeywell Regulator Co. Proposers: W. A. Williams, C. W. Larson. Seconders: W. H. Shipp, P. A. Croney.

Steele, Harris, Student, City College of New York. Proposers: V. L. Nichols*, E. B. Smith*, Seconders: H. A. Rothbart*, S. J. Tracy*.

Sutton, Geoffrey, Tech. Exec., J. G. Wagstaff, Ltd. Proposers: G. R. Addie*, Alfred Hindley*. Seconders: W. Taylor*, W. E. Barraclough*.

Swartling, Eugene R., Engr., General Air Conditioning & Heating Co., Inc. Proposers: O. D. Paulson, D. L. Williams. Seconders: C. D. Williams, S. W. Terry.

Walker, Kenneth A., Mech. Engr., Area Engineering Office. Proposers: M. C. Lobstein, J. J. Philippi. Seconders: M. J. Bamond, C. M. Burnam, Jr.

Wallis, William E., Student, Texas A. & M. College. Proposers: W. E. Long, J. S. Hopper. Seconders: Carl Files, C. W. Crawford.

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Weager, Theodore A., Jr., Sales Engr., The Buffalo Forge Co. Proposers: R. E. Sherman, P. B. Fleming. Seconders: J. E. Wilhelm, L. E. Slawson.

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Wiegand, Horace M., Sr. Process Engr., Servel Inc. Proposers: J. F. Wright, N. E. Berry. Seconders: C. T. Boyer, M. A. Raney*.

Wilson, James E., Engr. & Estimator, Dallas Air Conditioning Co. Proposers: A. F. Avera, M. L. Brown. Seconders: J. P. Ashcraft, R. E. Allison.

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*Non-member.

CANDIDATES ELECTED

In the past issues of the Journal of the Society the names of the following men were listed as Candidates for Membership. The membership grade of each Candidate has been assigned by the Committee on Admission and Advancement and balloted upon by the Council. We are now instructed by the Council to post herewith, as required by Art. B-III, *Section* 8, of the By-Laws, the following list of candidates elected:

Members

Bryan, Lloyd W., Partner, Rocky Mountain York Co., Denver, Colo.

Dane, Irving S., Widger Miller Corp., South Boston, Mass. *(Reinstatement)*

Murhard, Kenneth R., Mgr., Htg. Dept., Peerless Pacific Co., Portland, Ore. *(Reinstatement)*

Shafer, Howard S., Branch Mgr., American Blower Corp., Oklahoma City, Okla.

Associate Members

Bird, G. L. H., R. A. Lister & Co., Ltd., Gloucestershire, England. *(Reinstatement)*

Bromberg, Sidney, Supt. of Constr., Straus-Frank Co., Houston, Tex.

Campbell, Ralph L., Engr., Coast-to-Coast Stores, Minneapolis, Minn. *(Reinstatement)*

Jungmann, Edward C., Mech. Engr., Mead and Hunt, Madison, Wis.

Kothe, Robert B., Service & Installation Engr., Minneapolis-Honeywell Regulator Co., St. Louis, Mo.

Nightingale, George F., Sales Engr., C. H. Bevington Co., Chicago, Ill. *(Reinstatement)*

Rothenbach, Walter J., Sales Engr., John J. Nesbitt, Inc., New York, N. Y.

Vanderlip, P. J., Automatic Air Conditioning, Inc., Lansing, Mich. *(Reinstatement)*

Yeazel, George D., Sales Mgr., Wholesale Equipment Corp., Kansas City, Mo.

Junior Members

Johnson, Paul H., Student, Graduate School of Business, Stanford University, Calif.

Johnson, Sigurd O., Sales Engr., Buffalo Forge Co., New York, N. Y.

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Committee on Research

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7218 Euclid Avenue
Cleveland 3, Ohio
(Tel. EXpress 6161)

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CYRIL TASKER, *Director of Research*

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CONNECTICUT	L. A. Teasdale	A. J. Lawless
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INDIANA	G. B. Supple	T. R. Davis
IOWA	E. O. Olson	C. A. Wheeler
KANSAS CITY	P. C. Leffel	R. B. Mason
MANITOBA	Einar Anderson	J. R. Stephenson
MASSACHUSETTS	C. W. Larson	P. A. Croney
MEMPHIS	N. C. Ledbetter	J. B. Lammons
MICHIGAN	F. R. Bishop	A. E. Knibb
MINNESOTA	J. E. Haines	A. B. Algren
MONTREAL	A. B. Madden	F. A. Hamlet
NEBRASKA	D. E. McCulley	H. J. Kleinkauf
NEW YORK	W. A. Sherbrooke	M. C. Giannini
NORTH CAROLINA	C. Z. Adams	K. W. Selden, Jr.
NORTH TEXAS	C. R. Gardner	H. J. Martyn
NORTHERN OHIO	John James	W. R. Moore
OKLAHOMA	W. W. Frankfurt	J. H. Spaan, Jr.
ONTARIO	D. A. Stott	E. G. Spall
OREGON	W. B. Morrison	J. D. Kroeker
PACIFIC NORTHWEST	E. H. Langdon	W. M. Wallis
PHILADELPHIA	J. O. Kirkbride	L. A. Childs
PITTSBURGH	D. W. Loucks	E. H. Riesmeyer, Jr.
ROCKY MOUNTAIN	J. J. Johnson	H. J. Woehlke
ST. LOUIS	G. W. F. Myers	B. L. Evans
SOUTH TEXAS	C. C. Quin	D. M. Mills
SOUTHERN CALIFORNIA	Art. Theobald	R. A. Lowe
SOUTHWEST TEXAS	R. W. Barnes	
UTAH	E. J. Watts	C. E. Murdock
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Central Ohio: Organized, 1944. Headquarters, Columbus, Ohio. Meets, Third Monday. President, H. R. Allonier, 101 N. High St., Columbus 15. Secretary, W. M. Myler, Jr., P. O. Box 267, Columbus 16.

Cincinnati: Organized, 1932. Headquarters, Cincinnati, Ohio. Meets, First Tuesday. President, A. W. Edwards, Room 307, 626 Broadway, Cincinnati 2. Secretary, M. E. Mathewson, 1211 Enquirer Bldg., Cincinnati 2.

Connecticut: Organized, 1940. Headquarters, New Haven, Conn. President, P. D. Bemis, 36 Pearl St., Hartford 3. Secretary, Winfield Roeder, 405 Temple St., New Haven.

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Delta: Organized, 1939. Headquarters, New Orleans, La. Meets, Second Tuesday. President, W. P. Oster, 410 Camp St., New Orleans 12. Secretary, F. G. Burns, 317 Baronne St., New Orleans 9.

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Golden Gate: Organized, 1937. Headquarters, San Francisco, Calif. Meets, First Wednesday. President, James Gayner, 624 Hearst Bldg., San Francisco. Secretary, H. V. Hickman, 1129 Folsom St., San Francisco 1.

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Iowa: Organized, 1940. Headquarters, Des Moines, Ia. Meets, Second Tuesday. President, E. O. Olson, 3009 Sixth Ave., Des Moines. Secretary, D. C. Murphy, 214 Old Colony Bldg., Des Moines 9.

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Kansas City: Organized 1917. Headquarters, Kansas City, Mo. Meets, First Monday. President, S. L. Furber, 7429 Forest Ave., Kansas City 5. Secretary, H. E. Gould, 1800 Baltimore, Kansas City 8.

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Manitoba: Organized, 1935. Headquarters, Winnipeg, Man., Canada. Meets, Third Thursday. President, Robert E. Moore, 107-216 Graham Ave., Winnipeg. Secretary, J. R. Stephenson, 278 Main St., Winnipeg.

Massachusetts: Organized, 1912. Headquarters, Boston, Mass. Meets, Third Tuesday. President, C. W. Larson, 128 Brookside Ave., Jamaica Plain, Boston 30. Secretary, A. Ehrenzeller, 23 Parklawn Rd., Boston 32.

Memphis: Organized, 1944. Headquarters, Memphis, Tenn. Meets, First Monday. President, R. H. Hoshall, 65 McCall Pl., Memphis. Secretary, A. T. Bevil, 1521 Waverly Ave., Memphis 6.

Michigan: Organized, 1916. Headquarters, Detroit, Mich. Meets, First Monday after 10th of month. President, F. R. Bishop, 8011 Dexter Blvd., Detroit 6. Secretary, L. A. Burch, 5853 Hamilton Ave., Detroit 2.

Minnesota: Organized, 1918. Headquarters, Minneapolis, Minn. Meets, First Monday. President, J. E. Haines, 2747 Fourth Ave. S., Minneapolis 8. Secretary, O. L. Lilja, 5000 16th Ave. S., Minneapolis 7.

Montreal: Organized, 1936. Headquarters, Montreal, Que., Canada. Meets, Third Monday. President, T. H. Worthington, 405 Beaubien St., W., Montreal, Que. Secretary, S. W. Salter, 910 New Birks Bldg., Montreal.

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Nebraska: Organized, 1940. Headquarters, Omaha, Neb. Meets, Second Tuesday. President, H. Y. Kleinkauf, 514 S. 11th St., Omaha 8. Secretary, J. G. Bierl, 4927 N. 34th Ave., Omaha.

New York: Organized, 1911. Headquarters, New York, N. Y. Meets, Third Monday. President, W. A. Sherbrooke, 114 Liberty St., New York 6. Secretary, Carl H. Flink, Room 3000, 51 Madison Ave., New York 10.

North Carolina: Organized, 1939. Headquarters, Durham, N. C. Meets, Quarterly. President, C. Z. Adams, 312 Piedmont Bldg., P. O. Box 1356, Greensboro. Secretary, M. F. DuChateau, 205 S. Lyndon St., Greensboro.

North Texas: Organized, 1938. Headquarters, Dallas, Tex. Meets, Third Monday. President, C. R. Gardner, 1000 St. Louis St., Dallas 1. Secretary, G. A. Linskie, 3124 Milton St., Dallas 5.

Northern Ohio: Organized, 1916. Headquarters, Cleveland, Ohio. Meets, Second Monday. President, J. E. Wilhelm, 1906 Euclid Ave., Cleveland 15. Secretary, D. E. Mannen, Jr., 9104 Woodland Ave., Cleveland 3.

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Oklahoma: Organized, 1935. Headquarters, Oklahoma City, Okla. Meets, Second Monday. President, G. T. Donceel, Oklahoma Natural Gas Co., Oklahoma City. Secretary, W. W. Frankfurt, 519 Apco Tower, Oklahoma City.

Ontario: Organized, 1922. Headquarters, Toronto, Ont., Canada. Meets, First Monday. President, V. J. Jenkinson, 1221 Bay St., Toronto 5. Secretary, H. R. Roth, 57 Bloor St. W., Toronto, Ont.

Oregon: Organized, 1939. Headquarters, Portland, Ore. Meets Thursday after First Tuesday. President, W. B. Morrison, Cascade Bldg., Portland 4. Secretary, E. R. Lokey, 1238 N. W. Glisan St., Portland 9.

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South Texas: Organized, 1938. Headquarters, Houston, Tex. Meets, Third Friday. President, B. P. Fisher, P. O. Box 92, Houston 1. Secretary, C. C. Quin, 809 Stuart Ave., Houston 6.

Southern California: Organized, 1930. Headquarters, Los Angeles, Calif. Meets, Second Wednesday. President, Art Theobald, 116½ S. Kings Rd. Secretary, R. S. Farr, 2615 Southwest Dr., Los Angeles 43.

Southwest Texas: Organized, 1946. Headquarters, San Antonio, Tex. President, F. C. Benham, Jr., 702 S. Flores St., San Antonio. Secretary, R. W. Kotzebue, 438 Paseo Encinal, San Antonio 1, Tex.

Utah: Organized, 1944. Headquarters, Salt Lake City, Utah. Meets, First Wednesday. President, J. T. Young, Jr., Box 709, Ogden. Secretary, E. J. Watts, 2485 Douglas St., Salt Lake City 5.

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Virginia: Organized, 1946. Headquarters, Norfolk, Va. President, R. C. Thomas, 819 Westover Ave., Norfolk 7. Secretary, J. F. Reynolds, Gatling and Marble Ave., Norfolk 2.

•

Washington, D. C.: Organized, 1935. Headquarters, Washington, D. C. Meets, Second Wednesday. President, L. B. Nye, Jr., 1100 H St., N. W., Washington. Secretary, J. N. Stewart, 6124 32nd Pl., N. W., Washington 15.

Western Michigan: Organized, 1931. Headquarters, Grand Rapids, Mich. Meets, Second Monday. President, J. W. Miller, Route 5, Box 498, Lansing. Secretary, K. E. Robinson, 211 Smith Ave., Lansing 10.

Western New York: Organized, 1919. Headquarters, Buffalo, N. Y. Meets, Second Monday. President, Herman Seelbach, Jr., 45 Allen St., Buffalo 2. Secretary, F. J. Weber, 443 Delaware Ave., Buffalo 4.

Wisconsin: Organized, 1922. Headquarters, Milwaukee, Wis. Meets, Third Monday. President, E. W. Gifford, 611 N. Broadway, Milwaukee 2. Secretary, B. M. Kluge, 1817 S. 66th St., Milwaukee 14.

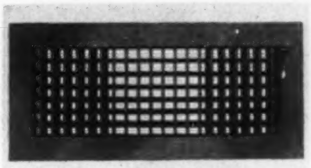
Student Branch

Texas A. & M. College: Organized, 1946. Headquarters, College Station, Tex. Meets, Third Thursday. President, K. W. Ryan, Texas A. & M. College, Box 701. Secretary, G. H. Jackson, Texas A. & M. College, Box 2787.

EQUIPMENT DEVELOPMENTS

For your convenience in obtaining more information about any of this equipment, see coupon on this page. Add the new products and companies listed here to your Directory Section which you received in your January 1947 Heating, Piping & Air Conditioning and thus keep your records of sources of supply up to date throughout the year. Single asterisk indicates equipment not listed in Directory Section; double asterisk equipment and manufacturer not listed.

Controls Register Air Delivery in Three Ways



No. 3362—**"Tri-Flex" registers and grilles for the control of air distribution on commercial and industrial air conditioning jobs have been announced by Tuttle and Bailey, Inc., New Britain, Conn.**

The new registers and grilles, offered in 26 standard sizes, are said to control the air delivery in three ways—control of direction, control of throw, and control of air drop. A multi-shutter damper is also used for volume control.

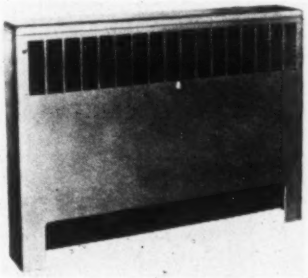
Completes New Addition

No. 3363—**A new addition containing 18,600 sq ft of floor space has recently been completed at the Marlo Coil Company's plant in St. Louis.**

The new construction provides greatly increased manufacturing and assembly space, with loading platforms to facilitate receiving and shipping.

This marks the fourth time in 13 years that the firm has enlarged its facilities. Beginning with 750 sq ft in 1925, the company's total factory area is now 42,600 sq ft, devoted entirely to the manufacture of heat transfer equipment of all kinds.

Convector Redesigned and Standardized



No. 3364—**The 1947 model convector-radiator offered by The Trane Co., LaCrosse, Wis., has been redesigned and standardized and is now available for free standing or semi-recessed installation on steam or hot water heating systems.**

According to the manufacturer, the unit is compact, light weight, and easy to install. Long life, economical service, and attractive appearance are said to be outstanding features.

Changes Color of Recorder Charts

No. 3365—**Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland 10, Ohio, has introduced recorder charts printed in neutral gray.**

This is said to make it easier for operators and supervising engineers to read the charts because of the greater emphasis given the various colored records by the neutral background. The new charts are designed to be especially valuable on recorders installed where lighting is poor or where it is impossible to get a clear view of the chart. Improvement in legibility is claimed especially with the dark colored recorder ink normally used, such as red, blue, and green.

The charts are made from wax engraved plates and center holes are punched simultaneously with the printing.

Gage Measures Pipe Thickness From Outside

No. 3366—**A new thickness gage, Type MS-A, designed to measure the thickness of iron or steel pipes from the outside, has been announced by the special products division of the General Electric Co., Schenectady, N. Y.**

The new instrument can be used on pipes up to ¼ in. in thickness and from 1 to 2 in. in diameter. Applications include checking the safety factor of pipes and tubing carrying petroleum products, chemicals, steam, or gas.

The gage consists of an indicating instrument, a gage head, and a saddle which is connected to the gage head by two screws. A different saddle is required for each diameter of pipe. To operate, the saddle is placed upon the pipe, and thickness is indicated in fractions of an inch on the indicating instrument.

The device is said to measure the average thickness of a pipe over an area of several square inches and with an accuracy of ±1/64 in. on clean surfaces and 1/32 in. on dirty surfaces. Dirt, scale, and paint on the inside of a pipe do not add to the thickness reading, according to the manufacturer. The gage head and saddle combination weighs about 6½ lb and the instrument operates on 115 volt, 60 cycle power.

Heating, Piping & Air Conditioning **[2-47]**
6 N. Michigan Ave., Chicago 2, Ill.

Please ask the manufacturers to send me more information about the equipment mentioned under the following reference numbers in Equipment Developments and Recent Trade Literature.

(Circle each number in which you are interested)

3362	3363	3364	3365	3366	3367	3368	3369	3370	3371
3372	3373	3374	3375	3376	3377	3378	3379	3380	3381
3382	3383	3384	3385	3386	3387	3388	3389		
6420	6421	6422		6424	6425	6426	6427	6428	6429
6430	6431	6432	6433	6434	6435	6436	6437	6438	

Name.................................. **Title**...............

Company ....

Address ....

City........................ **Zone**...... **State**...........

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ADJUSTABLE CLUTCH SCRUGUN . . . one of many Black & Decker models . . . automatically drives screws and nuts to uniform tension.

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For full information about all models . . . and other Electric Tools for heating, piping and air conditioning work . . . see your nearby Black & Decker Distributor. For your free copy of our 60-page, illustrated "Power Assembly Tool Data Book," write to: The Black & Decker Mfg. Co., 628 Penna. Ave., Towson 4, Md.

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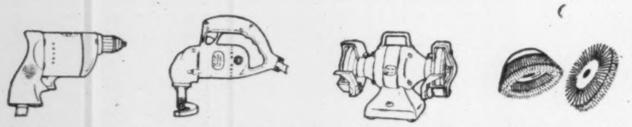
PORTABLE ELECTRIC TOOLS



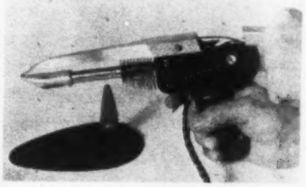
Provides Hot Water at Isolated Points

No. 3367—A steam and water mixer, designed to provide hot water at isolated points, has been announced by Sarco Co., Inc., 475 Fifth Ave., New York 17, N. Y.

The mixer is 26 in. in length and 5 in. in width at the head and includes a built-in, liquid-filled thermostat. A steam pipe and cold water line are connected to the unit, which provides the hot water in quantities which the manufacturer states are surprisingly large—for example, 200 gpm at a temperature rise from 50 F to 120 F and with a steam pressure of 75 psi.

The entire construction is brass with renewable valve heads and seats of stainless steel. Union connections are provided on the steam and water inlets and a relief spring is used to prevent damage from accidental overheating.

Production Soldering Iron Requires One Hand



No. 3368—A new type soldering iron, the "Eject-O-Matic" has been designed for production work by the Multi-Products Tool Co., Newark, N. J.

A spool of core solder fits into the pistol grip type of handle and is automatically fed to the tip by pulling a trigger. The amount of solder fed with each pull of the trigger is regulated by means of a micrometer adjusting wheel built into the handle. For continuous production work the core solder may be fed from reels mounted on or under the work bench.

The soldering iron, by freeing one hand of the operator, is said to reduce fatigue and to permit speeded up production. "Resinox" phenolic, a product of the plastics division of Monsanto Chemical Co., Springfield, Mass., is used in the handle.

Draft Control Uses Balanced Damper and Thermostatic Bi-metal

No. 3369—The thermostatic draft control, offered by Atlas Utilities Co., Inc., 17 Exchange St., Providence 3, R. I., is an automatic mechanical device designed to retard the loss of heat through the smokestack of commercial and industrial boiler installations.

As heat rises in the boiler, expansion of the bi-metal spring permits the damper plate to drop to a closed position and heat is retained in the boiler which otherwise would escape through the stack. Likewise, as heat is reduced in the boiler, contraction of the bimetal spring gradually raises the damper until maximum draft is restored.

Barometric stabilizers are used to compensate for changing atmospheric conditions.

Units are manufactured for larger boiler breechings of almost any size or shape, and are said to function well on coal or oil burning boilers and furnaces.

Manufacturer of Fittings Changes Company Name

No. 3370—The Ladish Drop Forge Co., Cudahy, Wis., has announced that the corporate name has been changed to the Ladish Co.

Inasmuch as forged and seamless welding pipe fittings are important products which the company offers, it was felt that the inclusion of the term, drop forge, in the company's name may have implied a limitation of products. According to the announcement, no change has been made in either the company's organization or policies.

Shock Absorber Designed for Low Frequency

No. 3371—A new shock absorber, designed for low speed or frequency of a machine, has been announced by the Vibration Eliminator Co., 10-28 47th Ave., Long Island City 1, N. J. Designated as the No. 140 Series vibration eliminator, the unit is said to be an isolator of relatively great static deflection.

By varying the durometer or hardness of the rubber the unit is available for loads between 100 and 400 lb each and at these loads a static deflection up to ½ in. can be obtained. This is said to assure high isolation efficiency for operating frequencies as low as 600 cpm.

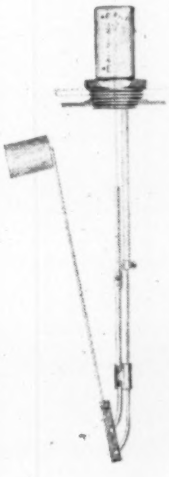
Low Water Level and Combustion Controls Combined

No. 3372—The "Fireye" combustion and low water level controls, manufactured by Combustion Control Corp., 77 Broadway, Cambridge 42, Mass., are now available in a single set of controls.

The company's photoelectric flame failure safeguard for oil, gas, or pulverized coal may be combined with the boiler feedwater control and with the low water safety device in various combinations. The equipment may be used with semi-automatic burners to control both main and pilot fuel valves; or with fully automatic burners, it may be used with a programming relay to provide the desired sequence of fuel pump, valve, and ignition operation.

Oil Tank Gage Is Sparkproof

No. 3373—An oil tank gage designed to accommodate all tanks with only two sizes has been announced by Bearlee Products Co., Green Bay, Wis.



The two sizes are 18 in. to 30 in. and 30 to 48 in. The combination threaded aluminum plug fits 1½ and 2 in. tank openings. To make the adjustment from 30 to 48 in. in depth it is only necessary to loosen two screws. All friction contact points are said to be sparkproof and all movable parts are either aluminum against aluminum or steel against aluminum.

The Flint glass top is threaded into the aluminum plug in contact with a special cork gasket. On the outside of the glass is placed black lettering on white background for easy reading and better visibility in dark places.

YOUR BEST AIR CONDITIONING EQUIPMENT DESERVES THE DEPENDABILITY OF AP REFRIGERANT VALVES

A-P Dependable Refrigerant Valves help you maintain peak operating efficiency at all times — the pride and proof of fine air conditioning, and the engineering skill involved in its installation. Prove this to your own benefit on new or present systems.

DEPENDABLE
MODEL 220-K
THERMOSTATIC
EXPANSION VALVE

Supersensitive, accurate provides closer superheat control over a wide range of operating temperatures. Capacity, up to 16 tons Freon.

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VALVE

Compact, rugged, leak-proof, quiet and positive in operation. Flange sizes for wide variety of applications. Opens quickly and easily on minimum power, even at high pressures. Capacity, up to 20 tons Freon.

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Export Dept., 13 East 40th Street, New York 16, N. Y.

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FOR AIR CONDITIONING • REFRIGERATION • HEATING

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Boilers made in 6 sizes
up to 3040 sq. ft.
E. D. R. steam.

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HEAT-PAK OIL BURNERS
AND BURNER-BOILER UNITS

. . . because the name, ALDRICH, means quality! It is a reputation attained after years of manufacturing experience, engineering leadership, designing skill. For conclusive proof of performance and efficiency on the job, Aldrich HEAT-PAK products were standard equipment in U. S. Insular Bases. Aldrich, the leading oil burner manufacturer, *guarantees* satisfactory performance!

Because Aldrich will not sacrifice standards of quality, production will be slow until the shortage of good materials is overcome.

Model AX
.75 to 5.00 G.P.H.

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KNOWN and USED the WORLD AROUND!

ALDRICH COMPANY
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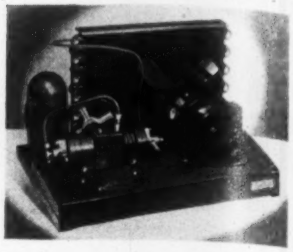
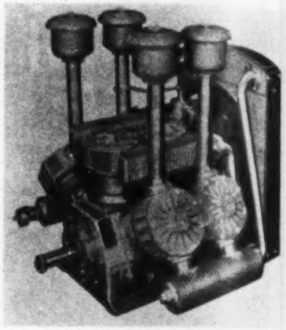
Offers Quick Delivery of Refrigerating Unit



No. 3374—Controldtemp Corp., 236 Butler St., Brooklyn 17, N. Y., is offering immediate delivery of a small refrigeration condensing unit.

The new packaged type, ½ hp, two stage unit is said to be suitable for a wide variety of applications and to be unusually compact and efficient.

Offers New 1947 Line of Portable Air Compressors



No. 3375 — The Davey Compresser Co., Kent, Ohio, is offering a new line of air-cooled portable compressors which includes five models of 60, 105, 160, 210, and 315 cfm capacity.

All units are of the v type cylinder design except the Model 315, which is of w construction with four low pressure and two high pressure cylinders. Units are said to operate at relatively low piston speeds through the use of short piston strokes, and aluminum alloy compressor heads and manifolds are used throughout. Other features are said to include the use of crankshaft mounting on heavy duty, double row ball bearings, force feed lubrication, and air cleaners for each low pressure cylinder.

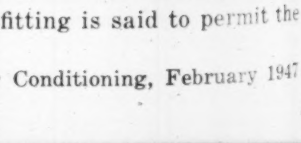
Recommends Moistening Solution for Air Filters

No. 3376—A fluid consisting of a 50 per cent solution of glycerine and water, to which has been added about 0.2 per cent glue, has been developed and is recommended by the Glycerine Producers Association, 295 Madison Ave., New York 17, N. Y., as a moistening fluid for air filters.

The procedure in making up the solution is to soak the glue overnight in a small amount of the glycerine solution and to dissolve the swollen glue in the remainder of the solution. The fluid is then applied by either spraying or dipping.

It is said that the filters, after a period of use, may be readily cleaned by immersion or spraying with either warm or cold water, and that they are then ready for recoating.

Stainless Steel Fitting Adapts Pipe to Tubing

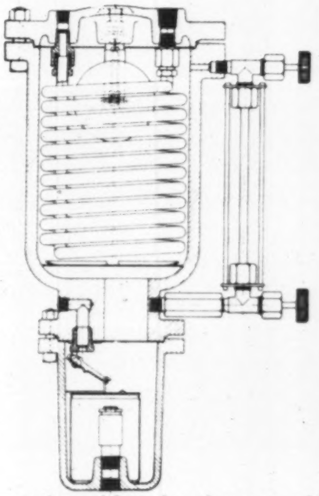


No. 3377*—The "Esco" P-T adapter is designed to join stainless steel tubing and standard IPS stainless steel pipe. It is offered by the Electric Steel Foundry Co., 2141 N. W., 25th Ave., Portland 10, Ore.

The use of this adapter fitting is said to permit the incorporation of stainless tubing in lighter takeoff systems from an already established standard piping layout and to make practical the use of tubing in the place of more costly standard stainless pipe in installations where the tubing would be equally suitable in other respects.

The tubing is butt-welded to the adapter, which is threaded to the standard pipe.

Refrigerating System Purger Features Coil



No. 3378 — Armstrong Machine Works, 874 Maple St., Three Rivers, Mich., has introduced a new noncondensable gas purger for refrigerating systems which is similar to the company's older models except that the refrigerating jacket has been replaced by an internal coil. It is said to provide 50 per cent more condensing surface.

Another outstanding feature is said to be the use of a new noncondensable gas discharge mechanism in which the ball float used to actuate the valve has been enlarged and the valve itself improved.

The unit is offered in two styles; No. 270 with semi-steel body for pressures up to 200 psi and No. 370 with a forged steel body for pressures up to 300 psi.

Direct Drive Axial Flow Fan Features "Tailor Made" Construction

No. 3379—Series 16 and 24 axial flow fans are of the large diameter type designed for handling air quantities up to 100,000 cfm at 4 in. static pressure and are offered by the Moore Co., 544 Westport Rd., Kansas City 2, Mo.

Although standard units are made of steel or monel, fans of other metals such as aluminum, bronze, stainless steel, etc., may be obtained. Motors are designed so that the outer part or rotor revolves about the inner part or stator. This is said to permit the blower hub to be mounted directly on the rotor, eliminating the use of drive shafts, keyways, etc.

According to the manufacturer, a "tailor made" blower can be provided for virtually each job as the use of a spherical hub permits standard blades and guide vanes to be used in various numbers and to be set at different angles.

BEND COLD PIPE
QUICKLY, EASILY

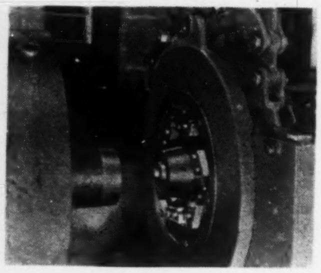
● Speed piping installations this efficient, easy, economical way . . . make "on the job" bends in pipe up to 4½" with a GREENLEE Hydraulic Bender.

With a GREENLEE *one man* makes smooth, accurate, uniform bends in a few minutes. You save greatly through elimination of manufactured bends, many fittings, and the work of threading them. And, in timesavings alone, the GREENLEE pays for itself quickly.

Simple to operate, easy to carry, set up, and shift from job to job . . . lets you bend pipe exactly where and when you want it. Ideal for radiant heating jobs. For complete details write for free folder S-121. Greenlee Tool Co., Division of Greenlee Bros. & Co., 2342 Twelfth Street, Rockford, Illinois.

REGISTERED TOOLS
GREENLEE
FOR THE CRAFTSMAN

Centers Die Head on Pipe Threading Machine



No. 3380—The "Centering Pilot" developed by the Landis Machine Co., Waynesboro, Pa., is designed for the company's 8⅝ in. and 13⅜ in. receding chaser pipe threading and cutting off machines.

The spring pilot is bolted onto the rear of the cross rail. Since this necessitates the removal of the cutting off slides, the machine is limited to threading only when equipped with the spring pilot.

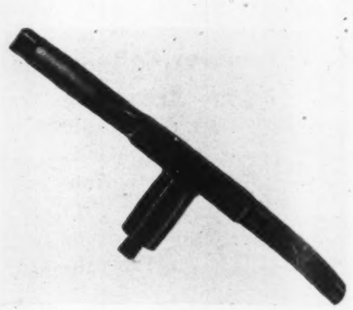
Since the device forms a center in the bore of the die head for centering the pipe with the die head, only the rear chuck of the machine is used to grip the pipe during the threading operation. It is necessary that the front chuck clear the pipe by approximately ⅛ in. to permit the pilot to fully engage the bore of the pipe.

In operation, the pilot is forced forward by a spring and engages the bore of the pipe prior to the pipe advancing to the chasers. The spring forces at the rear of the pilot are taken up by an anti-friction bearing. The 10 deg angle of the pilot is said to permit its use on different wall thicknesses of pipe.

The principal advantage of the unit is that it centers the pipe true with the die head assuring concentric threads and permits of higher threading speed, according to the manufacturer.

Torque Wrench Designed for Heavy Duty

No. 3381—A new T handle heavy duty, torque wrench, the "Jote," has been added to the line of torque tools offered by the Jo Mfg. Co., South Gate, Calif.



The new unit has a range of 90 ft-lb and is equipped with needle bearings. As in the case of all of the company's torque wrenches, the break comes by automatic impulse when the predetermined torque has been reached. The wrench is 10 in. long, 3½ in. high, has a ½ in. square drive, and is chrome plated.

Like the company's smaller wrench, it is preset at the factory or in the tool crib. At present it is being manufactured with just the nonratcheting action.

Low Hydrogen Electrode Announced

No. 3382—A new electrode, "Shield-Arc LH-70," designed to simplify the welding of high sulphur, free-machining steel and of certain high tensile, low alloy steels, has been announced by Lincoln Electric Co., Cleveland, Ohio.

IT'S AN
"OPEN AND SHUT CASE"
KIELEY 1879 MUELLER
250

for K & M's Revolutionary
KONTROL MOTOR
DIAPHRAGM VALVE

Just two simple quick-acting clamp screws to loosen, and your diaphragm casing is off. Tight-sealing clamp ring eliminates multiple bolts completely. Duo-seal molded diaphragm lips are automatically self-sealing.

67 years of control engineering "know how" produced this revolutionary new KONTROL MOTOR . . . featuring these design innovations:

- Pressed Steel Diaphragm Casing . . . lighter . . . tougher, more durable.
- Rigid Welded Steel *Tubular* Yoke.
- Long calibrated Steel spring . . . fully enclosed.
- Enclosed ball bearing Spring Adjusting Screw.
- Streamlined Flow Valve Body with high capacity . . . unrestricted flow areas.
- Super-finished Disc Guides, honed guide bushings, top and bottom . . . for minimum friction; increased life.

Used with air operated instruments or auxiliary pilot units, the K & M KONTROL MOTOR regulates the flow of steam, liquids or gases — efficiently and sensitively. Send us your control problems. We'll show you how the KONTROL MOTOR valves will solve them. Write for new KONTROL MOTOR bulletin.

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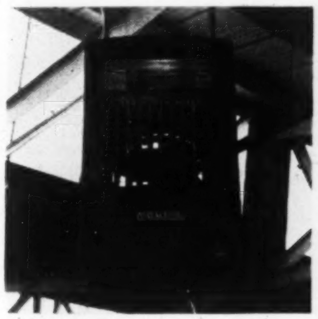
Represented in
New York City, Detroit, Cincinnati, Houston, Los Angeles, Rochester, Pittsburgh, Tulsa, New Orleans, San Francisco, Chicago, Baltimore, Dallas, Denver, Portland

KIELEY & MUELLER, Inc.
North Bergen, New Jersey

The new electrode has a low hydrogen, low moisture coating and is designed for use with d-c polarity, as the welded tensile properties are 70,000-80,000 tensile strength and elongation is 25 to 30 per cent. Welding currents used are high in comparison with other all-position type electrodes.

The electrode makes possible a weld in less time, according to the company, on a number of types of steel and will open the way for a much wider use of these steels than heretofore. Other features claimed by the manufacturer are: preheating of high tensile, low alloy steels can now be eliminated or largely reduced, welds of exceptional toughness can be made on high carbon and other steels which tend to show underbead cracking when welded with the usual type of electrodes, welding high silicon, electrical sheet steel is highly practicable with the new electrode, and high sulphur steels can be welded as readily as low sulphur mild steels.

Redesigns Gas-Fired Unit Heater



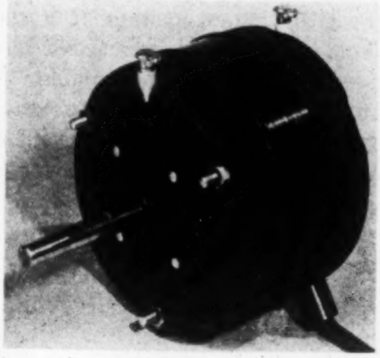
No. 3383—Now on the market is a new model "Palmaire" gas-fired unit heater of the suspended type. It is offered by the Palmer Mfg. Co., 705 W. Jefferson St., Phoenix, Ariz.

Approved by the American Gas Association, the heater includes a redesigned and streamlined cabinet of one piece, welded steel. Improved adjustable air deflectors have been added and a sliding drawer type assembly for the controls and burner is said to facilitate cleaning and inspection.

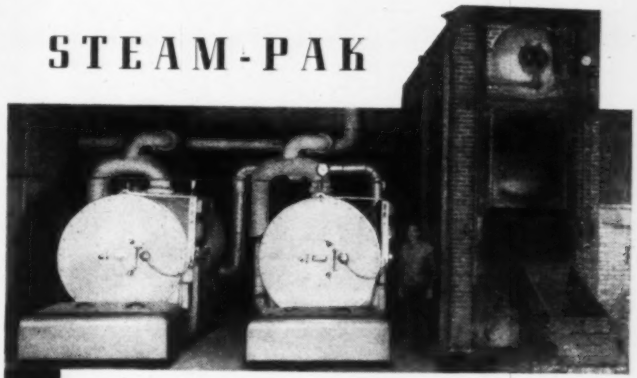
The fan type unit, shown here, with an output rating of 100,000 Btu per hr is now in production.

Small Shaded Pole Motor Designed for Use with Fans

No. 3384—The Model A, six pole shaded design, induction type motor has been developed by the Alliance Mfg. Co., Alliance, Ohio, for driving fan blades or for other intermittent duty where motor cooling is otherwise supplied.



The motor is 4½ in. OD, has porous bronze, oilless type sleeve bearings, is available in either open or fully enclosed construction, and is designed for use on 220 volt or less a-c current with frequencies from 50 to 60 cycles. Rated at approximately 1/30 hp, the full load running torque is approximately 8 to 40 in.-oz. Outstanding advantages are said to be extreme economy in operation, even, slow-running speed, and quiet performance. The speed may be controlled between 500 and 1050 rpm.



STEAM-PAK

GENERATORS
GO TO COLLEGE

STEAM-PAK
YORK YS HEAT
GENERATOR

At Woodstock College in Woodstock, Md., *two* SPL-100 (100 h.p. low pressure) *Steam-Pak Generators* have replaced *three* 80 h.p. boilers. It doesn't take a mathematics professor to figure out that a 200 h.p. system is now doing the work formerly done by a 240 h.p. job . . . to say nothing of the economy and convenience of *fully automatic* oil heat.

Steam-Pak Generators are built right, installed right, and serviced right by a factory-distributor-dealer organization that knows how. Complete lines of low pressure (heating) and high pressure (process steam) units range from 15 to 100 h.p. for No. 3, 5, or 6 oil. The 30, 50, 75, and 100 h.p. low pressure units are available for *immediate* installation. Industrial Division, York-Shipley, Inc., York, Pa.

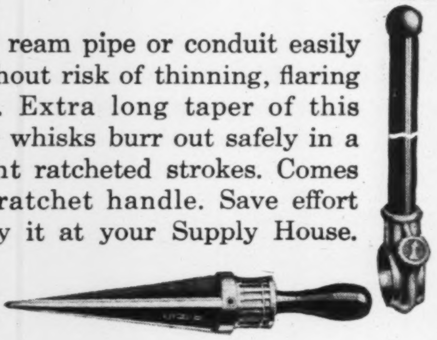
YORK-SHIPLEY
Oil-Fired Equipment for Industry
America's Most Complete Line

Request catalogs: ID-47-8C tells the sales story; ID-46-1C gives "facts and figures" about *Steam-Pak Generators.*

For Local Dealer: Call FOrdham 7-2069

Fast, safe
LONG TAPER
PIPE
REAMING
RIDGID
RIDGID
Extra-long-taper
reamer saves
you time, work
...and pipe

● Now you can ream pipe or conduit easily and quickly without risk of thinning, flaring or splitting it. Extra long taper of this RIDGID Reamer whisks burr out safely in a few feather-light ratcheted strokes. Comes complete with ratchet handle. Save effort (and pipe) — buy it at your Supply House.



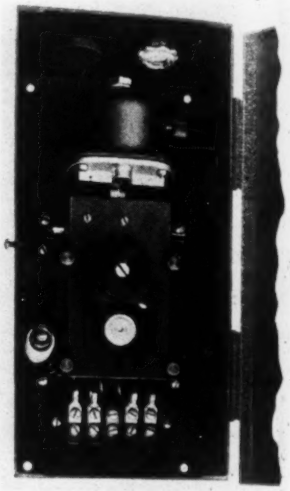
Reamer unit fits RIDGID *No. 00R Ratchet Threader Handle, also.*

RIDGID

WORK-SAVER PIPE TOOLS
THE RIDGE TOOL COMPANY • ELYRIA, OHIO

Control to Proportion the Flow of Electrical Energy

No. 3385—Taylor Instrument Companies, P. O. Box 110, Rochester 1, N. Y., has developed the "Electro-Pneumatic Interrupter," an auxiliary control device for proportioning the power input on applications where electrical energy is the source of heat.



A typical application of the device, a companion instrument to the company's "Fulscope" temperature controller, is the control of an electrical heating element located at the outlet of a ventilation or circulating fan. Output air pressure from the controller operates the interrupter to proportion the flow of electrical energy to the element so as to maintain a constant space temperature. Another common application is where water is heated by electrical energy and cooling is accomplished by a cold water supply. In this case the controller has its element located in the water to operate a water valve and the interrupter.

The unit consists of a synchronous speed motor, a ball bearing eccentric attached to the motor shaft, a reciprocating sliding plate, a single pole, double throw micro-switch attached to the sliding plate, and a low pressure bellows unit. The interrupter is designed for 110 or 220 volts, 25, 50, or 60 cycles as standard, and the micro-switch is rated at 10 amp at 110 volts and 5 amp at 220 volts, noninductive load.

Sound Slide Film on Regulator Controller Installation

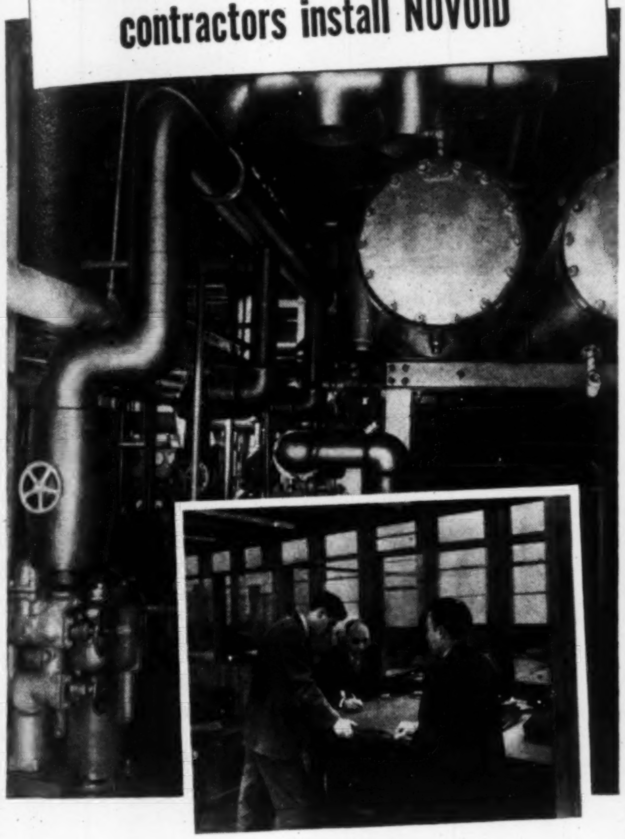
No. 3386—A new 35 mm sound-slide film showing methods of handling pressure and temperature control problems has been announced by Leslie Co., Delafield Ave., Lyndhurst, N. J., manufacturers of pressure and temperature regulators, controllers, strainers and whistles.

The film (running time about twenty minutes) follows the steam system of a typical industrial plant from the high pressure steam at the boiler through the power generating equipment, processing machinery, boiler auxiliaries, heating, and low pressure steam systems. Applications and installations of a variety of regulators and controllers are shown by photographs and diagrams. After reviewing general applications, the film analyzes which type of regulator is best for a given purpose.

The complete story is retold and illustrated in a handy 24 page booklet which is given each person at the conclusion of the show.

The film is said to be of particular interest to steam, power, and process engineers and is available at no cost for meetings of their groups.

All over America, leading insulation contractors install NOVOID



Since 1934, the Armor Insulating Company, of Atlanta, Georgia, has installed a large proportion of the principal insulating jobs in the Southeast. **Shown above** is the compressor room for the air conditioning system in the Roxy Theatre, Atlanta, where this firm covered pipes and tanks with Novoid Cork Pipe Covering and Novoid Cork Lagging. **In small picture** in the drafting room of the Armor Engineering Department Mr. B. H. Dunn, Vice President, discusses with two associates the application of Novoid Cork Insulation to a new job.

* * *

IMMEDIATE DELIVERY of Novoid Cork Pipe Covering can now be secured from outstanding insulation contractors in every part of the United States. Many sizes and thicknesses are available from warehouse stocks.

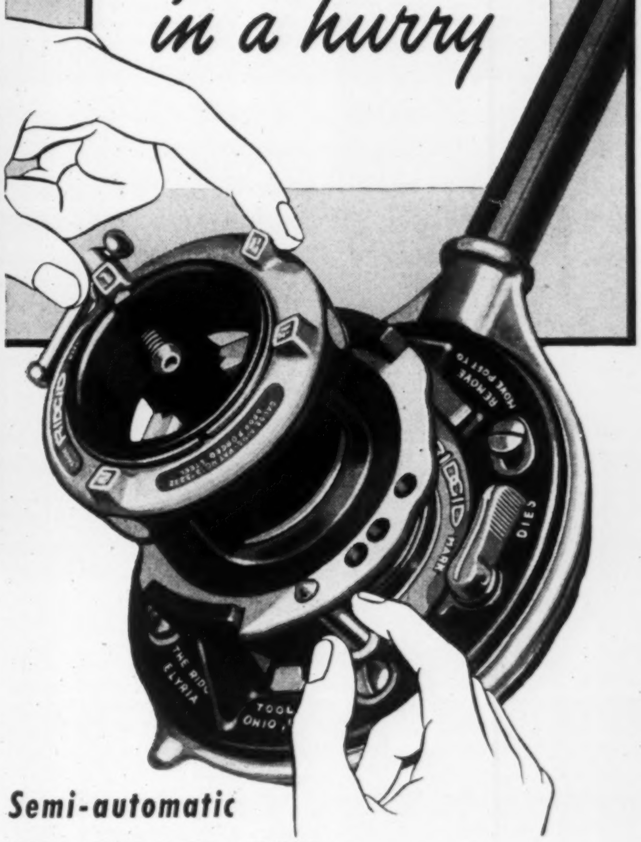
Novoid Covering is the moulded rigid insulation that efficiently reduces your cost of refrigeration. It snugly hugs pipes and fittings of every size and shape, does not sag, does not absorb moisture or odors, and is long-lasting.

For complete facts about Novoid Corkboard, Pipe Covering, and sundries specially developed to make low-temperature insulations most efficient, write to Cork Import Corporation, 39 Park Place, Englewood, N. J.

NOVOID INSULATION

CORKBOARD · PIPE COVERING

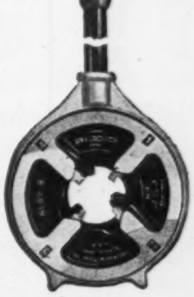
PERFECT PIPE THREADS *in a hurry*



Semi-automatic

RIDGID ***No. 65R is ready to thread 1" to 2" pipe almost instantly***

● When you have a self-contained No. 65R, there's no fooling around to thread 1", 1¼", 1½" or 2" pipe. Its one set of high-speed steel dies adjust to pipe size easily in 10 seconds. Mistake-proof workholder sets instantly—one screw to tighten, no bushings. Perfect threads quickly, with least effort. Every tool factory tested. More for your money — ask your Supply House for the No. 65R.



It stands up handily on the floor.

RIDGID

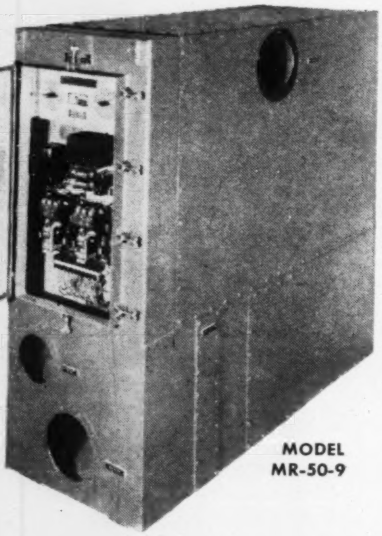
WORK-SAVER PIPE TOOLS

THE RIDGE TOOL COMPANY · ELYRIA, OHIO

NOW — Solve Your Moisture Problems with

DryNamic

the new packaged dehumidification



If you attended the recent Heating and Ventilating Exposition at Cleveland, you already know about DryNamic—the modern system for taking moisture out of the air.

The enthusiasm with which DryNamic was received—and the number of enquiries which have since been made—indicate a vital need and a wide market for this *new packaged dehumidification*.

And if you are concerned with the making, handling or storing of goods which are affected by airborne moisture, you will quickly see the value of this practical and economical system.

The DryNamic unit is entirely automatic, completely self-contained. When natural atmospheric conditions warrant, and dry air is not needed, DryNamic may be used solely for ventilation or shut down altogether.

To find out how DryNamic can best solve your moisture problems, write for the services of the DryNamic Technical Advisor. No obligation, of course.

KEEP IT DRY

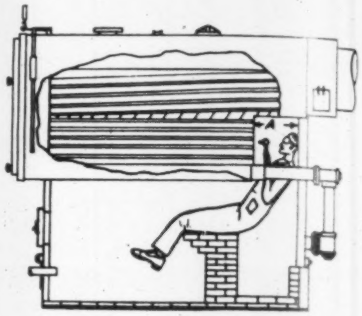
with DryNamic

A product of

CARGOCAIRE ENGINEERING CORPORATION
15 PARK ROW, NEW YORK 7, N. Y.
Washington • San Francisco • Seattle
Montreal • London • Gotenborg

Short Cutting Torch for Fire Tube Boiler Work

No. 3387—A short, oxyacetylene cutting torch with an overall length of 13 in. has been developed by Air Reduction Sales Co., 60 E. 42nd St., New York 17, N. Y., to facilitate the repair of fire tube boilers.

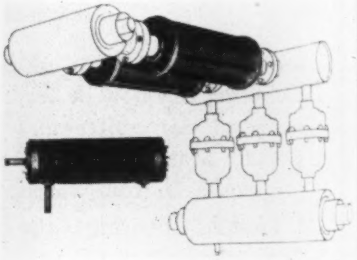


This lever type torch, which can be furnished with either a 45, 75, or 90 deg head, is said to be particularly adaptable to the removal of worn tubes from the type of heating boilers commonly found in office buildings, schools, factories, large homes, and stores where low pressure steam is required for heating or process work.

According to the manufacturer, when retubing, it is the practice of skilled repair men to "wash off" the flanging or beading on the tube, and then to make three or four gouges on the inner surface. If carefully done, the entire wall is cut without injury to the tube sheet and without cutting through the outside of the tube and depositing slugs. Contraction after cooling then permits drawing the tube out through the front end of the boiler.

Air, Gases Heated, Steam Superheated

No. 3388—The "Aridizer" is a finned heat transfer unit for heating air and gases and for superheating steam which has been developed by Goodyer Industries, Inc., 224 S. Michigan Ave., Chicago 4, Ill.



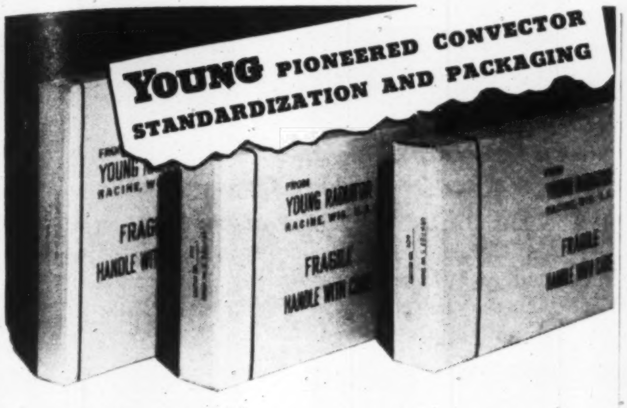
According to the manufacturer, this unit can be adapted to any existing drying or dehydrating system, will maintain temperatures up to 1000 F within ±1 F, and is suitable for many applications in the food processing, rubber, chemical, petroleum and printing industries.

The unit, said to be small and compact with accessibility to all vital parts, may be heated by electric calrods, oil, or gas burning equipment.

Expands Air Eliminator Valve Line

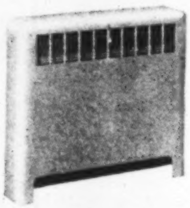
No. 3389—Expansion of the line of air eliminator valves manufactured by the Risselt Division of Lodge & Shipley Co., Special Products Div., Cincinnati, Ohio, has been announced.

The new valve is designed for industry-wide use and is said to be applicable for all steam processing. The unit can also be used on high pressure heating up to and including 125 psi. Deliveries are scheduled for the early part of the year.

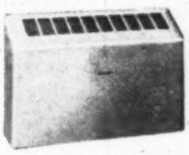

YOUNG PIONEERED CONVECTOR STANDARDIZATION AND PACKAGING
FROM YOUNG RADIATOR RACINE, WIS.
FRAGILE HANDLE WITH CARE

● Selecting the right convector for any building is an easy task today . . . made easy by Young, the pioneer in standardized convectors. *Standardization* has simplified specifications, guaranteed quicker delivery and speeded-up installation. It has made mass production techniques possible thereby making this modern heating equipment available at a low price. *Packaging* has hastened handling, lessened danger of damage. "Streamaire" Convectors soon may be ordered direct from stock. Write for your copy of the "Streamaire" Catalog today. It illustrates the convection principle and advantages and describes each of the "Streamaire" Convector models.

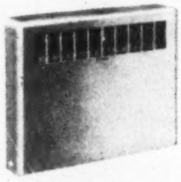
FOUR "STREAMAIRE" STYLES MEET EVERY NEED



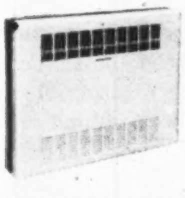
FREE-STANDING TYPE "C"
Saves on installation costs; ideal for remodeling or new construction.



WALL-HUNG TYPE "WS"
Sloping top grille prevents careless blocking of air circulation.



WALL-HUNG TYPE "W"
Off-floor installation makes routine floor cleaning easy.



PARTIALLY-RECESSED TYPE "S"
Special "Z" Bars permit installation before or after plastering.

YOUNG

HEAT TRANSFER PRODUCTS

OIL COOLERS • GAS, GASOLINE, DIESEL ENGINE COOLING RADIATORS • HEAT EXCHANGERS
INTERCOOLERS • EVAPORATIVE COOLERS • ENGINE JACKET WATER COOLERS
GAS COOLERS • UNIT HEATERS • CONVECTORS • CONDENSERS • AIR CONDITIONING UNITS • EVAPORATORS • HEATING COILS • COOLING COILS
AND A COMPLETE LINE OF AIRCRAFT HEAT TRANSFER EQUIPMENT

YOUNG RADIATOR CO., Dept. 117-B, RACINE, WIS., U. S. A.
Sales and Engineering Offices in all Principal Cities

Here it is!
ASCO

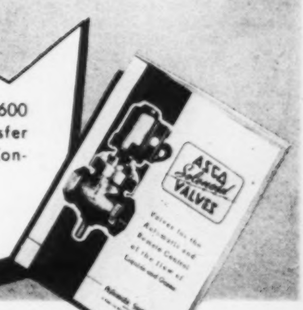
A STURDY *Hand-size* SHUT-OFF VALVE FOR *Giant-size* CONTROL JOBS

There's nothing flimsy about this trim little ASCO Two-Way Solenoid Valve. Extra heavy, forged brass body standard, or special alloy body and trim for corrosive conditions . . . stainless steel renewable seats and disc . . . conduit connection box integral with solenoid housing . . . continuous duty coils . . . capable of opening and closing at frequencies of 400 times per minute.

No, there's nothing flimsy about this ASCO Two-Way Shut-off Valve. Nor is it particularly fussy about what it handles, being designed for air, water, gas, refrigerants, light oils, and many chemicals.

Send for descriptive literature so that you can study the merits of this ASCO Valve in relation to your automatic shut-off valve requirements.

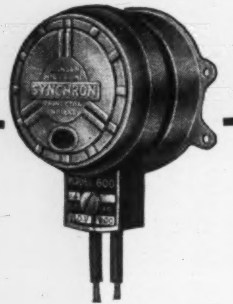
Circular 200 describes briefly many of the other ASCO Solenoid Valves. Send for a copy for future reference. Also, if interested in switches, send for Circular 600 describing our line of Automatic Transfer Switches, Remote Control Switches, Contactors, Relays.



Automatic Switch Co.

49-C EAST 11th STREET NEW YORK 3, N. Y.

TIMING MOTOR- ACCURATE DEPENDABLE



For the Makers of All Types of Timing Devices

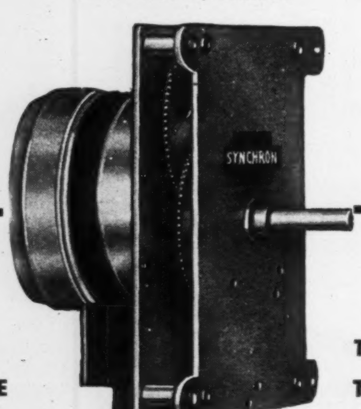
You want controlled power—consistent power—for time controls and time switches. Power that is measured evenly with every electric impulse, giving utmost accuracy and reliability to the carefully geared machines you build. You get this power with

SYNCHRON
TIMING MOTORS
AND
TIME MACHINES

These power units are built to take it—with oil-impregnated double bearings, brass gears, hardened steel shafts—and a reputation for customer satisfaction that dates a quarter of a century.

SYNCHRON synchronus motors are small—only 2¾" by 1 5/16"—with power to pull 8 oz. direct load continuously at 1 RPM. This time-tested motor powers the SYNCHRON Time Machine, a compact little "timer" with a proved record for sustained accuracy and reliable service under all types of working conditions. For complete details, write

HANSEN MANUFACTURING CO., INC.
Princeton 6, Indiana



TIMING MACHINE TIME-TESTED

NEW BOOKS & REPORTS

Says Air Conditioning and Refrigeration Offer Many Opportunities

The anticipated expansion of the refrigeration and air conditioning fields spells opportunity for many new independent businesses, according to a booklet, Air Conditioning and Refrigeration Business, just issued by the Department of Commerce.

The purpose of the booklet is "to explain the nature of the refrigeration and air conditioning business, set forth some of the opportunities in the field, and explain what skills are needed to successfully operate a small business within the industry. While many aspects of the industry are really big business and require considerable capital, there are opportunities for successful enterprises for the man with but a small amount of capital to invest in his own business."

Discussing the place of small business in the industry, the booklet states: "The fields of specialization in this industry which offer opportunities for the development of a small business include small ice plant operation, locker plant operation, repair and service of home equipment, repair and service of larger equipment, consulting and design service, parts manufacture, factory representative, wholesaler, retailer and assembler."

The first two chapters of the booklet are devoted to a discussion of the nature of the business and the basic principles of mechanical refrigeration and air conditioning. The third chapter deals with requirements and training for the guidance of veterans and others who may plan to enter this field, and states that it is highly important that a prospective enterpriser pick the line of work to which his talents are best suited.

A chapter is devoted to establishing a business as dealer, covering this subject in detail. Another chapter is designed chiefly for guidance in setting up a business as contractor and engineer in the air conditioning and refrigeration field. The various factors to be considered in establishing new enterprises in the manufacturing or distribution segments of the industry are set forth in another chapter.

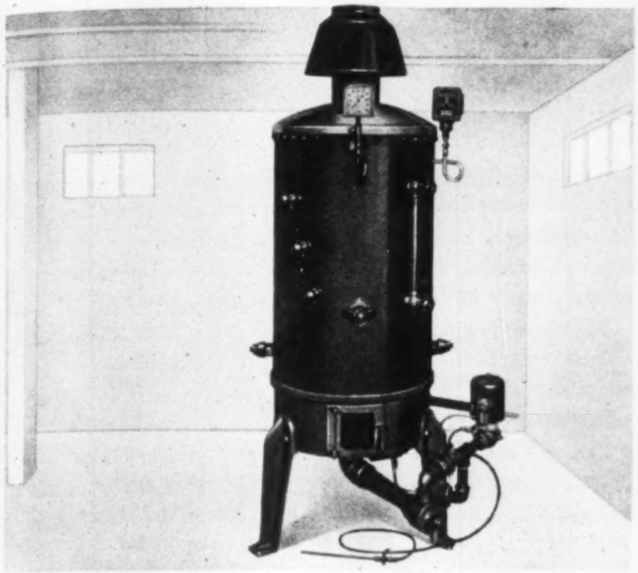
Business organization and outlook is also discussed. Among the subjects covered are different types of business organization, financing, G.I. loans, insurance, labor relations, legal and other requirements, the development of marketing methods in the industry, and market trends.

A considerable amount of data is given in the appendices. This includes a list of applications of refrigeration and air conditioning, an organization chart of marketing methods, statistics of air conditioning installations in the United States, the ratio of store occupancy to population, and a reference list of directories and trade papers.

Establishing and Operating an Air Conditioning and Refrigeration Business was written by V. C. Kyleberg, William L. Beck, and Howard E. Way under the supervision of the machinery and metals section of the industry division, Office of Domestic Commerce. A large number of business and professional organizations and

Heating Contractors:

This *SMOOTH-SURFACE* Boiler Gives "*SMOOTHER*" *SERVICE!*



This McKee Automatic "Off-On" steady-pressure STEAMBOILERPLANT is rivetless, all-welded construction. Complete, factory-built unit, ready to install and use; "condenses" costs for you and your customers. Built "better than code".

McKee Gas-fired
STEAMBOILERPLANTS

There's a STEAMBOILERPLANT to meet every one of your customer's needs, whether he has a steady steam demand or intermittent, and to suit any application or process where hot, dry steam is needed, FAST.

That's one reason why more and more heating contractors are specifying and installing STEAMBOILERPLANTS. Another is, they know that McKee engineers have had long experience working with heating engineers and contractors on process-steam-generating equipment problems.

McKee Eclipse

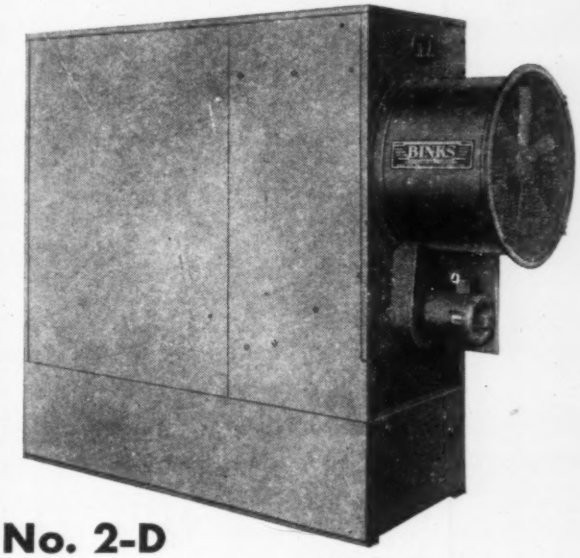
ECLIPSE FUEL ENGINEERING CO.

767 SO. MAIN STREET • ROCKFORD, ILLINOIS

Engineers in all principal cities

INDUCED DRAFT COOLING TOWERS

34 STANDARD SIZES



No. 2-D

Binks No. 2-D Horizontal Induced Draft Cooling Towers are *all-purpose* water cooling units for use indoors or outdoors where water conservation is important and where natural air movement is inadequate. The spray principle of water distribution is used. The No. 2-D provides the correct ratios of air to water and travel flow to give maximum cooling at lowest cost. Single fan sizes are available with capacities from 3 to 150 G.P.M. Twin fan models have capacities from 180 to 300 G.P.M.

There's a Binks Cooling Tower for every water cooling job.

WRITE NOW FOR BULLETIN No. 601

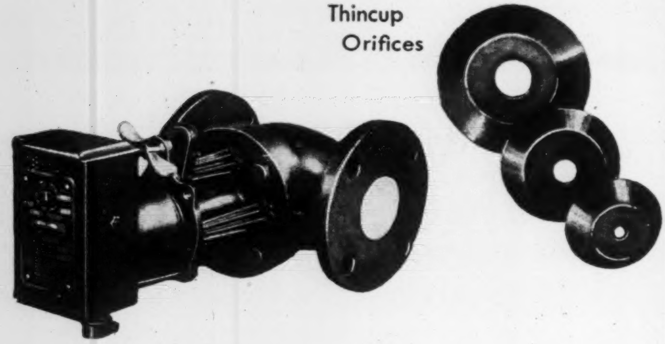
Bulletin No. 601 is a 12-page descriptive booklet packed with specification data, dimensions, helpful charts, etc. about Binks No. 2-D Horizontal Induced Draft Cooling Towers. Drop a postcard in the mail today for your free copy.

BINKS MANUFACTURING COMPANY

3114-40 CARROLL AVE. • CHICAGO 12, ILL.

Offices in all principal cities

TALLMADGE
ON-OFF HEATING CONTROLS
Combine Simplicity and Low Cost



Tallmadge On-Off Heating Controls are available in a variety of combinations that meet most heating requirements for thermostat regulation. Their advantages are widely recognized by leading engineers, heating contractors and building owners.

The controls for each zone include a rugged type "C" Motorized Valve regulated by a positive-action thermostat. The type "C" Valve shown, can, at any time, readily be converted to a modulating type valve. Thincup Orifices for insertion in radiator inlets are also provided to maintain even distribution of steam to all parts of the heating system.

Tallmadge Controls are backed by 18 years' experience in meeting all steam heating requirements in institutional, commercial and industrial buildings.

Complete detail information will be supplied on receipt of an inquiry indicating your general requirements whether for On-Off or Modulating types of heating systems.

FOR IMMEDIATE DELIVERY
(1) Motorized Valves
(2) Vacuum Breakers
(3) Thincup Orifices

WEBSTER TALLMADGE & CO., INC.
364 GLENWOOD AVE., EAST ORANGE, N. J.

individuals actively cooperated in its preparation.

Copies of the booklet can be purchased from the field offices of the Department of Commerce or from the Superintendent of Documents, Washington 25, D. C., at 20 cents each.

Tells How to Prevent Industrial Accidents

After two and a half years of research and preparation, the National Safety Council has published its new Accident Prevention Manual for Industrial Operations, which the Council believes is the most comprehensive treatment of the fundamentals of safety available in one volume.

The 544 page manual, containing 400 illustrations, charts and tabulations, is intended as a handy and authoritative source of accident prevention information for safety directors, safety engineers, and foremen. Each of the fourteen major divisions of the book is preceded by a summarizing index for quick location of general topics, while a twelve page detailed alphabetical index at the back gives access to details.

Although prepared primarily for the manufacturing industries, much of the information is applicable to nonmanufacturing industries and to those with industrial operations.

The major subjects covered are: plant design and layout, construction and demolition, permanent equipment and facilities, guarding and operating machinery, materials handling and storage, electrical hazards, chemical hazards, fire and explosion hazards, flammable liquids, hand and portable power tools, commercial vehicle operation, personal protective equipment, industrial hygiene, and safety organizations and programs.

The manual is available to both members and nonmembers of the Council. Further information may be obtained by writing the National Safety Council, 20 N. Wacker Drive, Chicago 6, Ill.

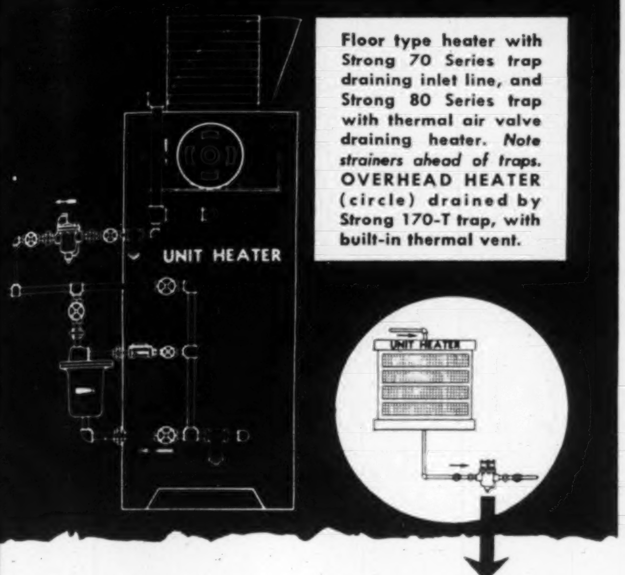
Presents Technical Data on Aluminum Alloys

Physical, mechanical, and chemical properties of aluminum alloys and mill products are contained in a new data book. Much of the information on chemical compositions and mechanical properties such as density, coefficient of expansion, thermal and electrical conductivity, annealing and heat treating cycles is tabulated. Chapters on mill products cover such subjects as manufacturing methods, alloys and tempers, identification, tolerances, weights, bend radii, pressure calculations (for tubing and pipe), and similar information.

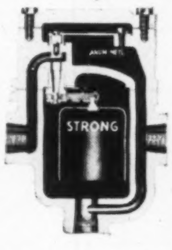
A section on related specifications is arranged according to alloy designations. These are then broken down into various product forms and related applicable specifications are listed. These include Federal, Army and Army Air Forces, Navy, Army-Navy, Aeronautical, SAE handbook, AMS and ASTM specifications.

The data book contains 248, 6 x 9 in. pages, 106 tables, and is wire bound. Copies are available from the Reynolds Metal Co., Dept. 47, 2500 S. 3rd St., Louisville 1, Ky. The price is $2.00.

MORE HEAT · FASTER WITH LESS FUEL!



Floor type heater with Strong 70 Series trap draining inlet line, and Strong 80 Series trap with thermal air valve draining heater. *Note strainers ahead of traps.* OVERHEAD HEATER (circle) drained by Strong 170-T trap, with built-in thermal vent.



Strong 170-T trap with integral thermal air vent and new HI-CAP* Orifice. Available in sizes from ½" to 1¼".

*Reg. Trade Mark

Accumulated condensate and trapped air can make unit heaters slow in starting. Uncertain drainage will seriously reduce heat output.

LEAKY TRAPS WASTE FUEL

While *all* Strong Inverted Bucket Traps will handle large amounts of air, the hookups shown here provide thermal air vents for practically instantaneous heating. Use of Strong traps, guaranteed for a year against leakage, insures positive drainage without waste of steam.

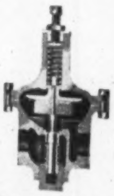
Completeness of the Strong line enables us to recommend exactly the right type and size of trap you need—open or inverted bucket, closed float, float-and-thermostatic (blast), etc.—semisteel, cast, forged and welded construction. Send your drainage problems to us for the *right* solution.

STRONG, CARLISLE & HAMMOND COMPANY
1392 West 3rd Street
Cleveland 13, Ohio

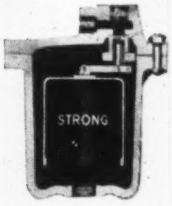
REG. TRADE MARK

ANUM-METL
Reg. Trade Mark

OTHER STRONG STEAM SPECIALTIES



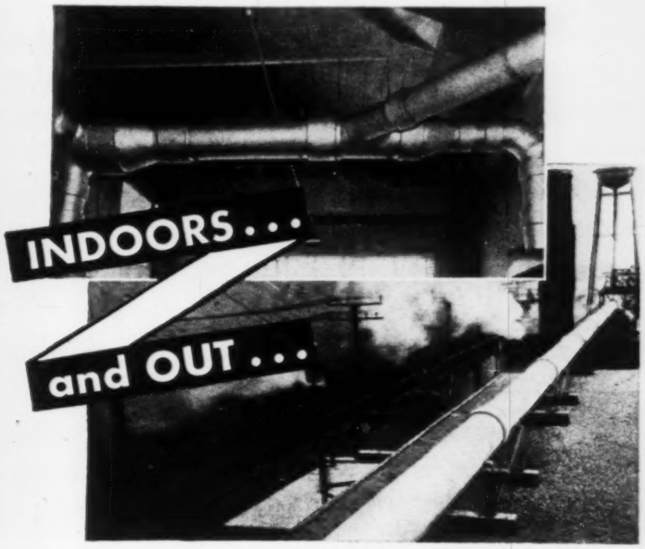
Reducing Valve



No. 80 Series Trap

Strainer

STRONG



Here is a duct that Fights Corrosion!

MANY USERS of ducts, vents and stacks have found, in Johns-Manville Transite Industrial Vent Pipe, a practical answer to the problem of corrosion.

Strong and durable, this asbestos-cement pipe successfully resists many of the corrosive fumes, vapors, dusts and gases encountered in industrial operations.

Transite Industrial Vent Pipe is also immune to rust, as well as highly water-resistant. It needs no painting, whether used indoors or out. It is easily installed, light in weight, and comes in a range of sizes up to 36" in diameter. A full line of Transite fittings assures corrosion-resistance throughout the system.

Data Sheet DS-336 gives full details and is free on request. Address Johns-Manville, 22 East 40th St., New York 16, N. Y.

JOHNS-MANVILLE JM PRODUCTS

Typical Industries in which Transite Industrial Vent Pipe is used

Aircraft
Automobile
Baking
Bleaching
Boiler Works
Brewing
Canning
Ceramic
Chemical
Dairy
Drug
Electrical
Explosive
Farm Machinery
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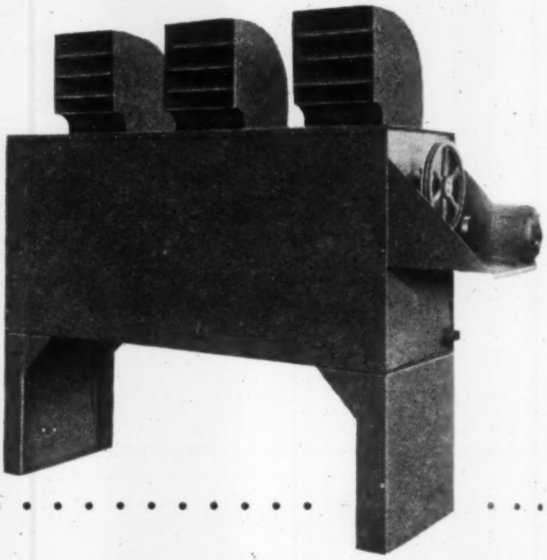

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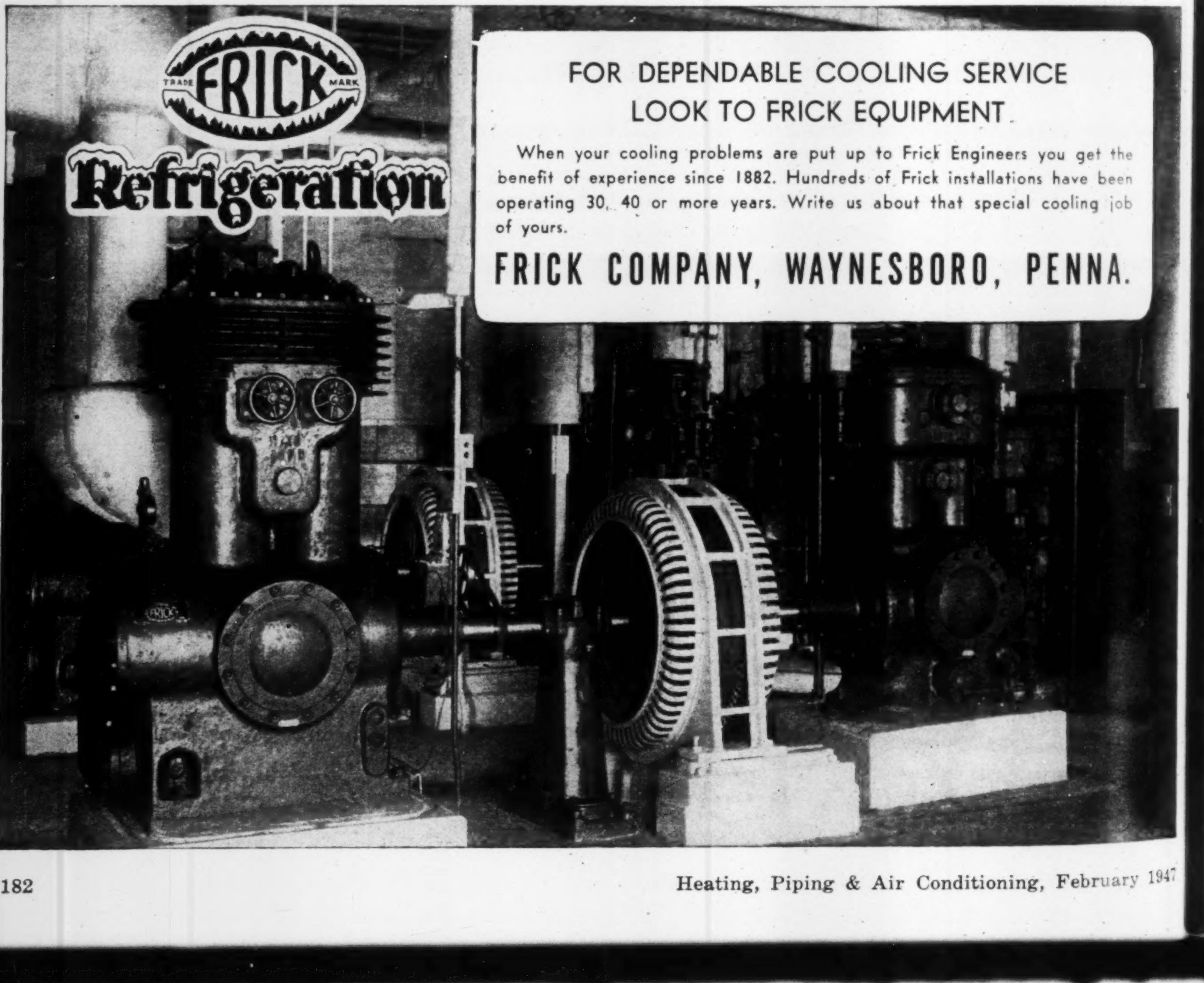

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MEETINGS & CONVENTIONS

ASME Schedules 1947 Meetings

The American Society of Mechanical Engineers meeting schedule for 1947 has been announced from national headquarters, 29 W. 39th St., New York City. The schedule includes:

Spring meeting, Tulsa, Okla., Mayo hotel, March 2-5

Oil and gas power 19th national conference, Cleveland, Ohio, May 21-24

Semi-annual meeting, Chicago, Ill., Stevens hotel, June 16-19

Applied mechanics 13th national conference, in June, time and place not set

Fall meeting, Salt Lake City, Utah, Hotel Utah, Sept. 1-4

Industrial instruments and regulators division, 2nd national conference, Chicago, time not set.

Petroleum mechanical engineering conference, Houston, Tex., Oct. 6-8

Fuels division, joint meeting with the coal division of the American Institute of Mining and Metallurgical Engineers, Cincinnati, Ohio, time not set

Annual meeting, New York City or Atlantic City, Dec. 2-5

Production Conference to Have 35 Technical Sessions

Designed to cover every phase of the production cycle, the Chicago production conference, March 17-19 in the Stevens hotel, will have 35 conference sessions devoted to production-line and general management techniques. Some of the subjects to be covered include applied research, modern management, designing the modern factory, new uses and sources of heat and power, welding and brazing, and instrumentation and controls.

Supplementing the conference the concurrent Chicago production show will have exhibits by 130 manufacturers of new materials, tools, handling and packaging equipment, instruments, and miscellaneous services. P. A. Jenkins is executive secretary of the Chicago Technical Societies Council, 53 W. Jackson Blvd., Chicago 4, Ill., sponsor of the show.

Lubricating Engineers Schedule Technical Sessions

The American Society of Lubrication Engineers, 55 E. Washington St., Chicago, Ill., has scheduled four technical sessions, a number of luncheon meetings, a smoker, and a banquet for its second annual meeting, to be held March 17-19 at the Hotel William Penn, Pittsburgh, Pa.

Program Completed for OHI Annual Convention

March 24-26 are the dates of the 24th annual convention of the Oil-Heat Institute of America, 30 Rockefeller Plaza, New York 20, N. Y. The meeting, which is to be held at the Hotel Traymore, Atlantic City,

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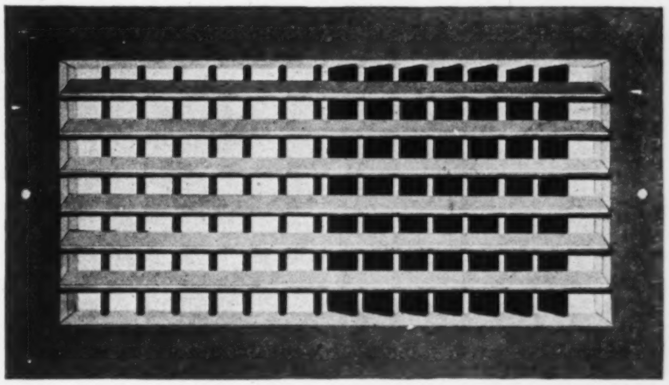
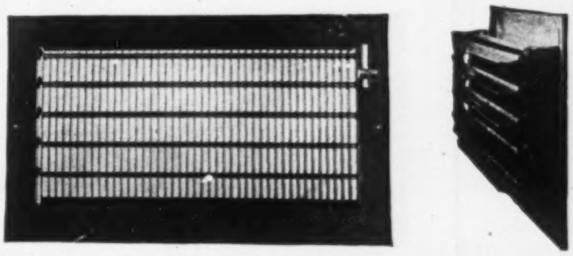


HIGH VELOCITY OUTLETS

Style DDH above is one of 8 variations of Stewart High Velocity Outlets that can be supplied with or without volume valves. Each bar is adjustable with a key (furnished). This unit is a heavy attractive Outlet made in all popular sizes, with matching fixed-bar down-deflecting return grille. *HIGH VELOCITY OUTLETS CAN BE SUPPLIED TO FIT CONTOUR OF CABINETS FOR ROOM COOLERS.*



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Style 74—Register. This Register utilizes 1" multiple-dampers to control volume and vertical direction. Multiple dampers may be set so as to obtain up, straight, or down deflection, as well as complete shut-off. The face is the same as all others of the "70" line—permitting air reflection right or left by adjusting front blades with key furnished. Blades are 1/4" center to center, and 1/4" in depth.

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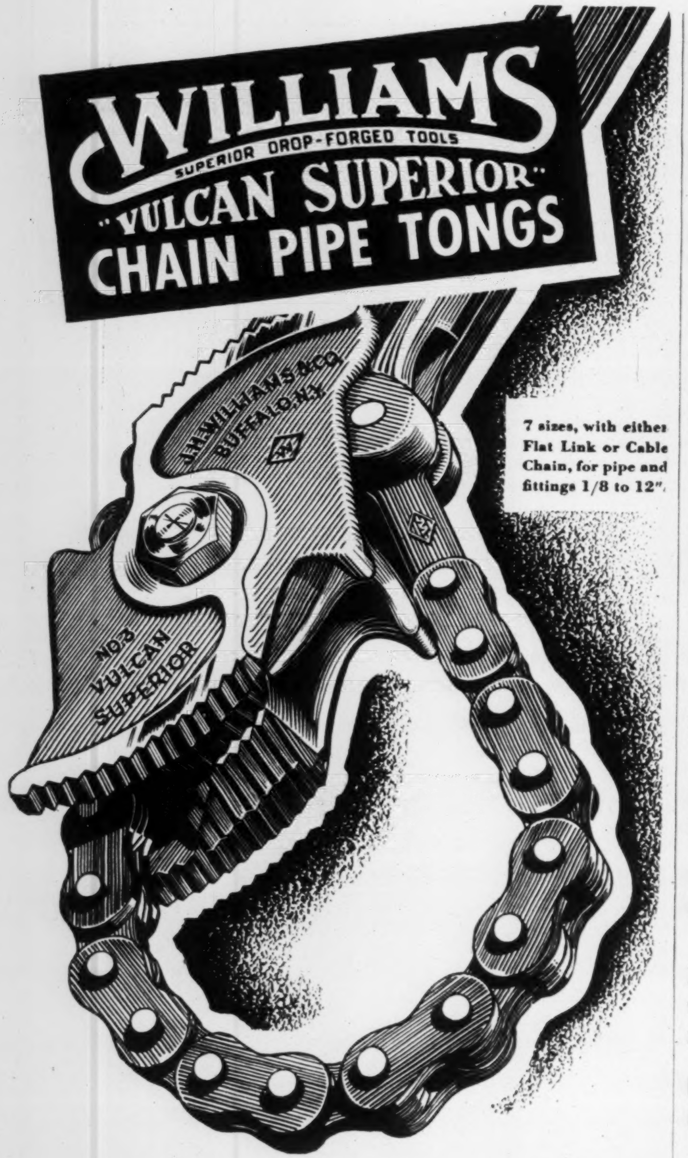

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N. J., is expected to be unusually broad and comprehensive. According to the program, convention days have been designated as institute day, engineering day and industry day, in the order named. The engineering session is scheduled for 2:30 p.m., Tuesday, March 25.

Sponsors Power Conference

The Illinois Institute of Technology, 3300 S. Federal St., Chicago, Ill., in cooperation with nine midwestern universities and seven engineering societies, is again sponsoring the Midwest Power Conference. This year the meeting will be held at the Palmer House, Chicago, March 31, April 1 and 2. E. E. Whitehead, research professor at Illinois Tech, is conference secretary.

NACE Meeting to Feature Exhibition

In addition to the five technical sessions planned, an exhibition featuring the latest developments in material, services, and equipment used in reducing corrosion will be a part of the meeting of the National Association of Corrosion Engineers, scheduled for the Palmer House, Chicago, April 7-10. Association headquarters is at 905 Southern Standards Bldg., Houston 2, Tex.

Plans June Meeting at Lookout Mountain

The Stoker Manufacturers Association, 307 N. Michigan Ave., Chicago 1, has selected Lookout Mountain hotel, Lookout Mountain, Tenn., for its annual meeting which will be held June 16-18.

NDHA Members to Meet in Atlantic City

The 38th annual meeting of the National District Heating Association will be held at the Ambassador hotel, Atlantic City, N. J., June 16-19. Association headquarters is at 827 N. Euclid Ave., Pittsburgh 6, Pa., and J. F. Collins, Jr., is secretary-treasurer.

Smoke Association to Meet in Toronto

Arrangements have been made to hold the 40th annual meeting of the Smoke Prevention Association of America July 8-10, at the Royal York hotel, Toronto, Canada. Association headquarters is at 139 N. Clark St., Chicago 2.

Plans West Coast Chemical Show

An industrial chemical conference and display for the western states and Pacific area are scheduled for the Civic Auditorium in San Francisco, Oct. 21-25. This is the first regularly scheduled Pacific Chemical Exposition and will be presented by the California section of the American Chemical Society, whose headquarters is at the Whitcomb hotel, San Francisco. Marcus W. Hinson is the exposition manager.

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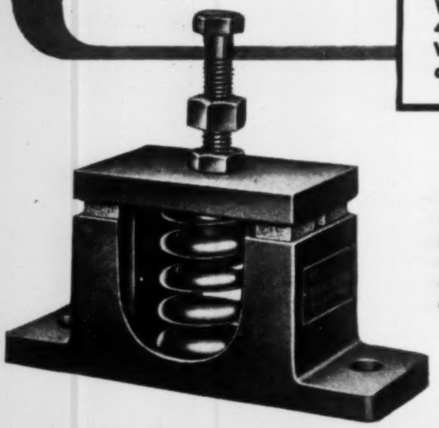

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Aluminum Fabricating and Processing

No. 6420—Reynolds Metals Co., 2500 S. 3rd St., Louisville 1, Ky., is publishing a new house organ, The Technical Advisor, which is designed to provide information on the latest methods of fabricating and processing aluminum and its alloys. The Vol. 1, No. 1 issue contains a brief history of the development of aluminum, a question and answer section on specific application problems, and the first of a series of abstracts, from the company's new handbook, on welding aluminum.

Close Coupled Centrifugal Pump

No. 6421—The Quimby Pump Division of H. K. Porter Co., Inc., Pittsburgh 22, Pa., has released an eight page pamphlet on the Model Q close-coupled centrifugal pump which is designed for general service with capacities from 10 to 1000 gpm.

Combustion and Low Water Level Controls

No. 6422—The "Fireye" photoelectric flame failure safeguard for use with oil, gas, and pulverized coal, together with the company's boiler feedwater control and low water safety device, is described and illustrated in bulletin 604 issued by Combustion Control Corp., 77 Broadway, Cambridge 42, Mass. Equipment may be obtained in a number of combinations to provide various safeguard functions.

Control of Radiant Panel Heating

No. 6423†—A 38 page manual on the control of radiant panel heating, which was prepared with the assistance of Prof. F. W. Hutchinson, Purdue University, has been published by Minneapolis-Honeywell Regulator Co., 2604 4th Ave., S., Minneapolis 8, Minn.

Beginning with a review of the theory of heating control and the basic functions of a heating system, the booklet compares the characteristics of panel and convective heating and stresses the importance of the so-called comfort equation. This equation indicates that the room air temperature should be maintained at a temperature lower than 70 F by as many degrees as the average surface temperature is above it; or conversely, the room air temperature should be maintained at a temperature higher than 70 F by as many degrees as the average surface temperature is below 70 F. This latter case is encountered in convective heating, but since the average surface temperature for most structures does not decline appreciably, it is common

---

†Copies of this manual may be obtained direct from Minneapolis-Honeywell for $1.00.

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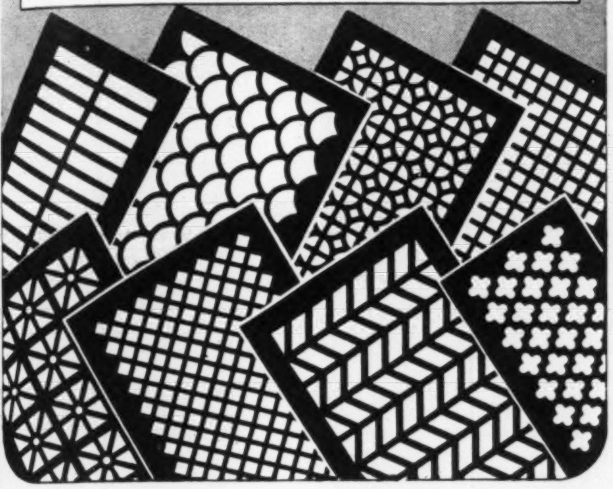

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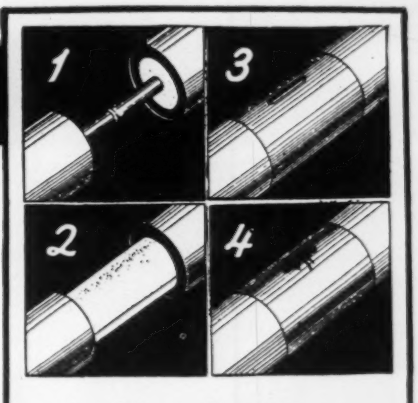

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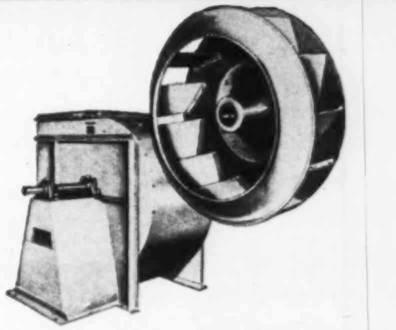

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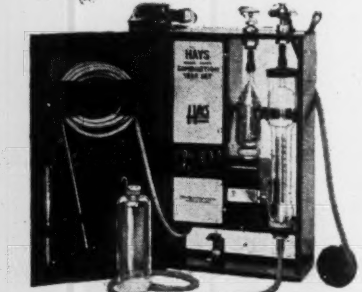

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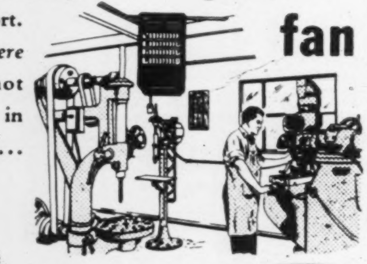

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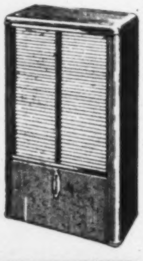

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practice to maintain the inside air temperature about 70 F with this type of heating.

Where radiant panels are used, however, the average surface temperature increases with a reduction in outside air temperatures. According to the manual, this means that conditions satisfactory to comfort cannot be expected if it is assumed that the purpose of a control system is to maintain a constant inside air temperature.

Based on Professor Hutchinson's work on the design of radiant panel systems (see December 1945, July and November 1946 issues of HPAC) a fundamental control equation is developed. Additional mathematical analyses are used to demonstrate that the relationship between inside air temperature and outside air temperature, for optimum comfort, is a straight line function. Graphs are provided so that using panel design data the required range of room air temperature may be determined.

Inasmuch as the problem of effective control, as distinguished from the required performance of the system, resolves itself into a question of thermal inertia or time lag, a good deal of space is devoted to this problem. Some of the complicating factors which are stressed are as follows:

Large capacity and resistance in the panel mean slow response to controls.

Large capacity and resistance in the structure mean delay in the reflection of external load changes within the structure.

Large capacity and relatively low resistance in the structure may cause instability of control from a room thermostat.

In general, effective control may be attained only if the lag of the panel is equal to or less than the lag of the structure.

A discussion of various types of control systems and a series of diagrams are used to indicate general methods which may be used under different conditions.

Cooking with Steam

No. 6424—Cooking with Steam is the title of a 28 page booklet issued by Market Forge Co., Food Service Div., Everett 49, Mass. The story of cooking with steam, its advantages, history, development, and importance in the field of cookery is told in this bulletin. In addition, tabulated data, definitions, and condensed information on preparation and cooking, weights, measures, steam pressures, and cooking time are included.

Corrosion Resistant Fans

No. 6425—Corrosion resistant fans constructed of high silicon iron alloy and stainless steel are covered in Bulletin 1102 released by the Duriron Co., Inc., Dayton 1, Ohio. The fans are available in capacities up to and including 5000 cfm and are recommended for handling corrosive vapors.

Dust Collectors

No. 6426—"Hydro-Whirl" dust collectors of the rotor, pump, and orifice types, together with grinding booths and special collectors are described and illustrated in bulletin No. 101 issued by Peters-Dalton, Inc., 17900 Ryan Rd., Detroit 12, Mich. In these units the dust and air are mixed with the liquid by high velocity impingement or centrifugal action and the material to be col-

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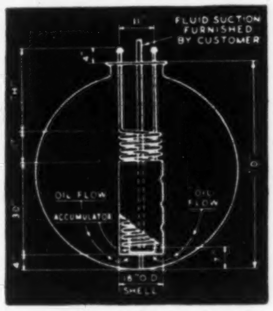

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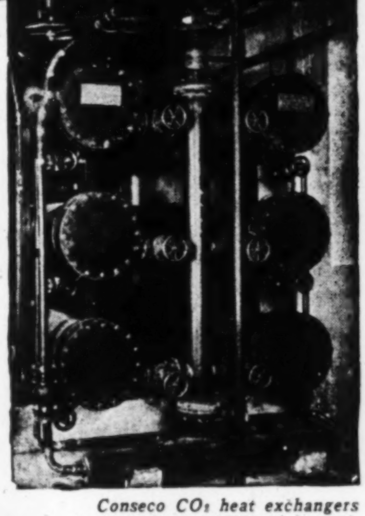

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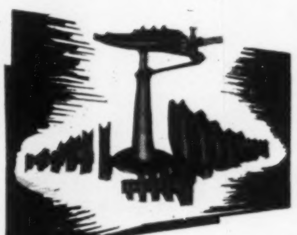

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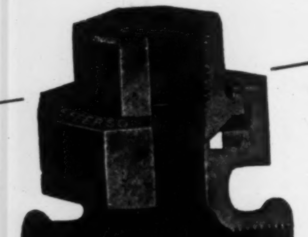

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You can save yourself labor time by specifying and installing Jefferson Specialty Unions on your piping jobs. These union tees with the union on the outlet take the place of an all-female union, two nipples, and an ordinary tee, thus saving three joints and much assembly labor. Available in All-Female and Male and Female threads.

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601 West 26th Street, New York 1, N. Y.
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lected is precipitated in the liquid. Pertinent and simplified data on selection and installation are included.

Heating, Ventilating, and Air Conditioning Equipment

No. 6427—Among the featured articles in the Vol. 10, No. 5 issue of the house organ published by The Trane Co., La Crosse, Wis., is a description of the use of the company's "Climate Changer" in soundproof recording booths, hot water heating equipment in an apartment project which provides 63 dwellings, and the use of steam coils and a large centrifugal fan for heating a bus garage. A brief description of the central system, the unit system, and combined systems for air conditioning multi-room structures is also included.

Industrial Oils and Greases

No. 6428—Industrial oils and greases including cutting oils, processing oils, general lubricants, refrigeration and diesel oils, solvents, and waxes are briefly described in a four page pamphlet issued by the Sun Oil Co., Philadelphia 3, Pa.

Low Temperature Arc Welding Electrodes

No. 6429—The Vol. 4, No. 4 issue of the house organ published by Eutectic Welding Alloys Corp., 40 Worth St., New York 13, N. Y., is devoted to announcing the development of the company's "Lowtemp Eutectrodes" for arc welding cast iron, stainless steel, copper and aluminum alloys. According to the manufacturer, lower base metal temperatures are possible with these flux-coated electrodes. Technical data such as bonding and remelting temperatures, Brinell hardness, strength, color match, etc. on both the company's welding rods and electrodes are contained in a recently issued bulletin, E-2.

Mechanical Felts

No. 6430—A comprehensive discussion of the nature, construction, properties, method of specification, and applications of mechanical felts is contained in the November 1946 issue of Felt Facts, published by The Felt Association, Inc. Much of the data is tabulated for ready reference and the issue has been arranged for the information and guidance of engineers, designers, and manufacturers of products in which felt may be an ingredient. Copies may be obtained from Korbell & Colwell, Inc., 480 Lexington Ave., New York 17, N. Y.

Mercury Relays

No. 6431—"Merctron" mercury relays are described and illustrated in a two page bulletin (No. 46) issued by Ebert Engineering & Mfg. Co., 185-09 Jamaica Ave., Hollis 7, Long Island, N. Y. Units have hermetically sealed tungsten contacts with mercury to mercury make and break in an inert gas, and are available for loads up to 35 amp at 110 volt a-c or 25 amp at 220 volt, a-c.

Motors for Tube Cleaners

No. 6432—Two new motors, one air-driven and one water-driven, for tube cleaning are covered in a new two page leaflet issued by the Elliott Co., Roto Division,

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Thermometers**
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**Controllers
for Time, Pressure
and Temperature**
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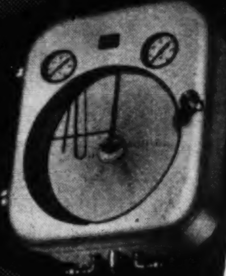
and Recorders**



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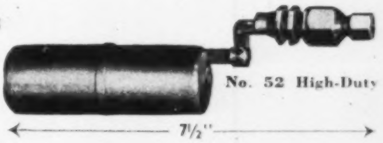
Accurately maintains water line as low as 1" deep—thumb screw adjustment. Entire valve made of non-ferrous metals. Easy to install by drilling one hole. Capacity one quart per min. at 50 lbs. pressure; maximum pressure, 75 lbs.



No. 52 High-Duty

Same general design as No. 51 — but built for larger capacities. Handles 1½ gals. per min. at 75 lbs. pressure; maximum PRESSURE, 125 lbs. Fully adjustable.

No. 53 High-Duty Bracket Valve

Same construction and capacities as No. 52. Only difference is vertical mounting of VALVE as shown. Overall length 5 9/16".

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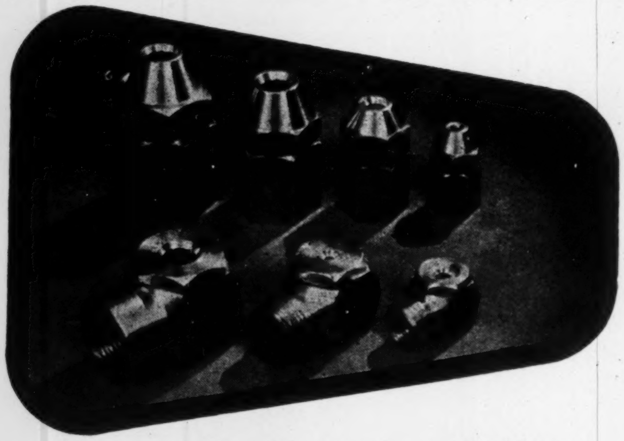

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145 Sussex Ave., Newark 1, N. J. Said to be the most powerful and efficient motors ever built for this purpose, they are suitable for use with existing "Roto" cutter heads and hose. The air-driven motor can be adapted to operate with steam.

Paint Spray Booths

No. 6433—Peters-Dalton, Inc., 17900 Ryan Rd., Detroit 12, Mich., has issued a new bulletin (No. 201) covering the company's line of "Hydro-Whirl" wet-type paint spray booths. Numerous sizes of these units, which are designed for all types of paint spraying, are described and illustrated. They are of the flood-sheet type with open baffles used to eliminate entrained moisture.

Pump Governors

No. 6434—Bulletin 463, a 16 page illustrated booklet giving engineering, operating, and maintenance data on pump governors for the control of reciprocating, turbine, and motor-driven pumps, has been issued by the Leslie Co., 51 Delafield Ave., Lyndhurst, N. J. Construction details of each class of the company's bronze and steel governors are illustrated and described. Both constant pressure and excess pressure pump governors are featured.

Registers and Grilles

No. 6435—Thirteen different designs of grilles together with the company's wall and ceiling registers are described and illustrated in catalog G, released by the Auer Register Co., 3608 Payne Ave., Cleveland 14, Ohio. Designed as a guide for the selection of grilles for all purposes, the booklet includes ordering information, dimensions, and installation recommendations.

Reverse Cycle Refrigeration Unit

No. 6436—Terra Temp Co., Inc., Indianapolis 4, Ind., has issued a pamphlet describing the company's packaged heat pump or reverse cycle refrigeration unit. Operating principles are illustrated by colored diagrams and 12 questions and answers are used to provide general information about the unit which uses the ground as the heat source—"Freon" being circulated in a pipe coil buried 3 to 4 ft below the frost level.

Smoke Abatement

No. 6437—The Perfex Corp., 500 W. Oklahoma Ave., Milwaukee 7, Wis., manufacturer of automatic temperature controls and instruments, has released a new booklet entitled Smoke—Its Cause, Cost and Prevention. Dealing with many phases of smoke prevention, the booklet was edited by M. W. Crew, manager of the company's controls division and chairman of the combustion equipment standardization committee of the Smoke Prevention Association of America. Copies are offered in limited numbers as a public spirited contribution to the educational aspect of the smoke abatement problem.

Steel, Iron and Bronze Valves

No. 6438—A new 248 page catalog has been issued by the Ohio Injector Co., Wadsworth, Ohio. Covering the company's line of steel, iron, and bronze valves, the catalog is designed to be a reference publication.

PRODUCTS WANTED

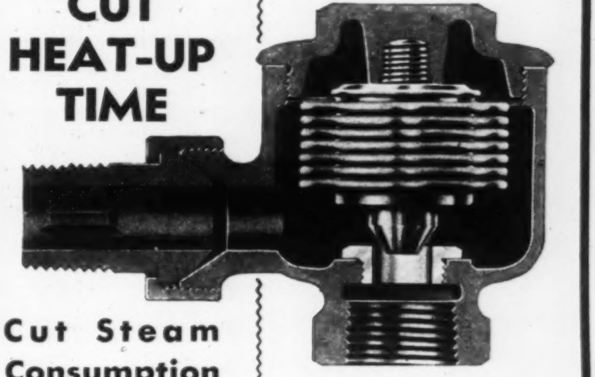
The Webster Company, manufacturers and distributors of heating and air conditioning equipment, have distributing centers in 18 principal marketing areas, located from New Haven, Conn. to Salt Lake City and from Birmingham, Alabama to Toronto in Canada. Their dealer outlets (approximately 4,000) virtually cover the entire country.

The Webster Company is seeking additional products allied to the heating equipment and air conditioning field and would like to contact manufacturers who desire wider distribution from this aggressive selling organization.

The Webster Co.
Webco Products
1915 University Ave. St. Paul 4, Minn.

NEW NICHOLSON RADIATOR TRAPS

CUT HEAT-UP TIME



Cut Steam Consumption

Utilizing a patented vapor-pressure principle which speeds action, and large-orifice valves which effect greater discharge, the new line of Nicholson radiator traps are producing 3-way savings: in heat-up time, in steam, and in fuel. Two types, for 200 and 400 sq. ft. EDR, vapor and vacuum; pressure to 25 lbs. Competitively priced.

BULLETIN 744 describes new traps

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